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17 JANUARY 1990



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# ***JPRS Report***

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# **Science & Technology**

***China***

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# Science & Technology CHINA

JPRS-CST-90-002

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**Priority Research Programs Set for 1991-1995**

40101008a Beijing XINHUA in English 14 Dec 89

[Text] China will give priority to 85 selected basic research programs in the 1991-1995 period, according to Wednesday's Overseas Edition of THE PEOPLE'S DAILY.

The 85 research programs are expected to receive an estimated 100 million yuan (\$27 million) from the State Natural Sciences Foundation Committee, which is also responsible for selecting key projects and allocating funds. The key programs aim to boost scientific research in fields such as agriculture, resources, energy, the environment, and population. The committee will, for the first time, solicit applicants nationwide for those programs, the paper said.

The committee, founded in 1986, has chosen 66 basic research programs with 60 subjects as priority and provided nearly 100 million yuan for the programs in the Seventh Five-Year State Plan (1986-1990).

**Outline of Mid-Long Term S&T Development Laid Out**

90CF0046A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Sep 89 p 1

[Article by correspondent Zheng Qianli [6774 0578 6849]: "Outline of Mid-Long Term S&T Development Completed—Implementing Policy of Using Science and Technology To Promote Economic Growth"]

[Text] The "Mid-Long Term S&T Development Outline" which describes the requirements and prospects of S&T development in various key industries and technical disciplines was recently laid out by the State Science Commission. It will be submitted to the Chinese Communist Party Central and the State Council for approval. This "outline" contains over 300,000 words and involves nearly 5,000 experts. It is a gift to celebrate the 40th anniversary of the founding of our government.

After the First People's Congress of the 13th Party Plenum, the State Council put the State Science Commission to be in charge of the drafting of the "Outline of Mid-Long Term S&T Development." In order to provide a more in-depth description of the requirements and prospects of various key industries and technical disciplines, the "Mid-Long Term S&T Outline" was put together as a companion document to the "principle." State Councilman and State Science Commission Chairman Song Jian [1345 0256] personally guided the drafting of the "principle" and "outline." State Science Commission Standing Vice Chairman Jiang Minkuan [5592 3046 1401] was specifically in charge of the editing of the "outline" and drafting of the "principle."

The "outline" points out issues of vital importance to the technical, economic and social development in China in a variety of key industries and lays out the mid-term (up to year 2000) and long-term (up to year 2020) objectives and scientific policies.

The drafting of the "outline" began in July 1988 and took over a year to finish. It is divided into special fields such as agriculture, energy, transportation, machining building and electronics, information and communications, consumer goods industry, construction, geology and mining, medicine and hygiene and birth control, metals, chemicals, aerospace, forestry, oceanography, ecology and environmental protection and natural disaster prevention, basic and applied research, technical personnel, water resources, biotechnology, regenerative resources, construction materials, national security and defense industry, survey, and public safety. The "outline" of each industry or discipline has been debated by exports for 3-6 times. A total of 113 meetings were held. It was finally reviewed by the State Council experts who drafted the "principle."

In order to accurately summarize our past experience specifically based on the special circumstance in China, the "outline" was prepared with reference to the following five spirits. 1) Select direction of S&T development to address areas that have troubled us in economic and social development for a long time to give us the feeling of making significant breakthroughs in key areas. 2) Establish an overall picture which is a breakthrough by itself. 3) Combine mid- and long-term efforts and focus on mid-term objectives. 4) Provide a better handle on the relationship among the three levels in science and technology. 5) Pay attention to communications with science and technology communities in the world.

**National Funding Committee and International Cooperation**

90CF0046C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Sep 89 p 2

[Article released by the International Cooperation Bureau: "National Funding Committee Created Excellent Environment and Condition for International Cooperation"]

[Text] The National Funding Committee is actively establishing a long-term and stable relation with every national science committee and academic societies and has promoted multi-facet and multi-level international academic exchange and cooperation activities in a variety of forms. In the past 3 years, our efforts have resulted in some encouraging achievements. In the area of establishing agreements with foreign scientific organizations, we have reached mutual agreements with relevant scientific organizations in nine countries and territories such as Canada, Bulgaria, England, Federal Republic of Germany, Belgium, Austria, Switzerland, Sweden and Hong Kong. A number of high level supported projects are included in these mutual agreements. Based on these agreements, 250 technical people will be dispatched this year.

During the course of over 3 years, the National Funding Committee expanded its support modes in international

cooperation to six, i.e., fund supported projects to conduct joint research with other countries, support international academic meetings held in China, support people to attend international academic meetings abroad, support experts to visit other countries, fund foreign scientists to visit China and to give lectures, and support researchers to go abroad for further studies.

Based on the statistics compiled as of the end of August, the National Funding Committee has funded 359 research projects, supported 356 technical people to attend international academic meetings abroad, funded 131 projects involving the visit of foreign scientists to China, and supported 79 researchers to study abroad.

### **How Key Projects Are Selected by Foundation and the Organization of National Funding Committee**

*90CF0046D Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Sep 89 p 2*

[Article by Zhong Da [0112 6671]: "Major Projects Heavily Supported by the National Funding Committee and Organization of the National Funding Committee"]

[Text] In order to effectively advance the basic and applied research work in China, in addition to supporting a large number of selected unsolicited applications, the National Natural Science Funding Committee systematically organizes a number of promising key projects of scientific significance, concise objectives and sound foundation by providing a great deal of support to a group of high level research personnel to conduct joint studies.

The organization of these key projects began in 1986 and was in full operation in 1987. In the Seventh 5-Year Plan the National Funding Committee organized 85 key basic research projects. Sixty-six projects have been approved so far. They contain 460 subject matters and involve a total of 94,200,000 yuan. The major characteristics of these key projects are:

1. They have great scientific significance. Many projects are on the cutting edge in their own disciplines and have great significance to the development of science and technology. They will push us to play a leading role in areas of our strength, such as mathematics, theoretical physics, quantum chemistry, etc. Certain key projects are addressing major technical problems encountered in our economic construction efforts and have an excellent prospect in future applications, such as "exploration and study of non-linear crystals and laser crystals" and "research on the cause of flood and drought pattern along the Chang Jiang and Huang He and its forecast."

2. There is a team of high level research team consisting of old, middle-age and young technical people. A total of 8,041 research people were involved, 55 percent are high and medium level research personnel and 26 percent have a doctor's or master's degree.

3. It is comprehensive, inter-disciplinary, inter-departmental joint effort research. There are 265 institutions involved in these projects, including 96 higher learning institutions, 77 research institutes under the Chinese Academy of Sciences, and 92 research organizations associated with local industrial, transportation, agricultural and medical organizations.

4. The relation between immediate and long range, gearing to needs and reserving for the future, and applied and basic is correctly dealt with based on the S&T development strategy. Moreover, we are looking to link with the high technology development program associated with the Seventh 5-Year Plan. Specifically, we have to combine these projects with the national key laboratory plan to effectively utilize the basic research funding invested by the government. Among the 66 approved projects, 31 of them involve key national laboratories.

### **Organization of the National Funding Committee**

The National Funding Committee is set up to have bureaus (offices) to handle a variety of functions such as comprehensive planning, policy study, foreign cooperation and exchange, and administrative matters. In response to the need to support basic research studies, it has six departments including mathematics and physics, chemistry, biology, earth science, materials and engineering, and information. In addition, there is a management science group in the policy bureau. They are in charge of the application, review, monitoring, inspection and achievement management of every program in their own areas. Most of the people responsible for the bureaus and working in these academic departments are medium or high level employees. It is a highly academic, capable and dynamic organization.

### **Establishment of National Natural Science Foundation**

*90CF0046B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 19 Sep 89 p 2*

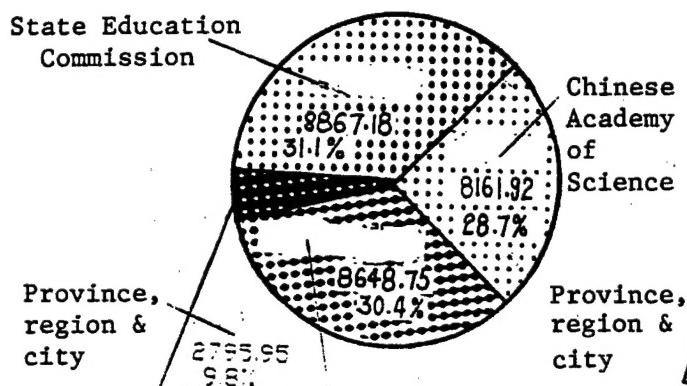
[Article by Tang Aoqing [0781 2407 1987], chairman of the Chinese National Natural Science Foundation: "March Forward in the Midst of S&T System Transformation"]

[Text] The National Natural Science Foundation was founded in February 1986 following the decision made in 1985 by the Party Central to reorganize the S&T system. Its charter, as given by the State Council, is to effectively spend funding for S&T development according to government guidelines, policies and plans, provide leadership, coordination and support for basic research and some applied research, discover and train technical talents, and promote technical progress and economic and social development. Since its founding, on the basis of key basic research projects originally supported by the Science Foundation of the Chinese Academy of Sciences and the State Science Commission, the National Natural Science Foundation took certain actions to strengthen the depth of technical

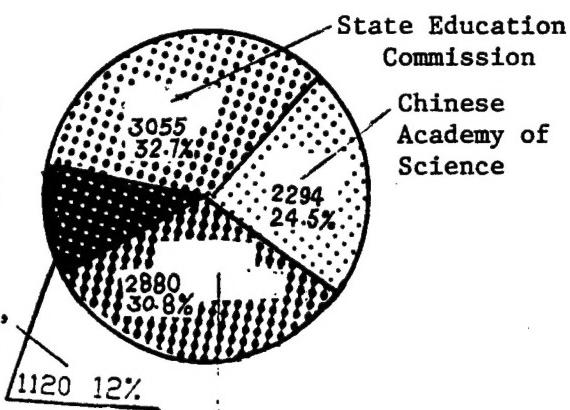
## SCIENCE & TECHNOLOGY POLICY

### Distribution of Funds and Projects (not including major items)

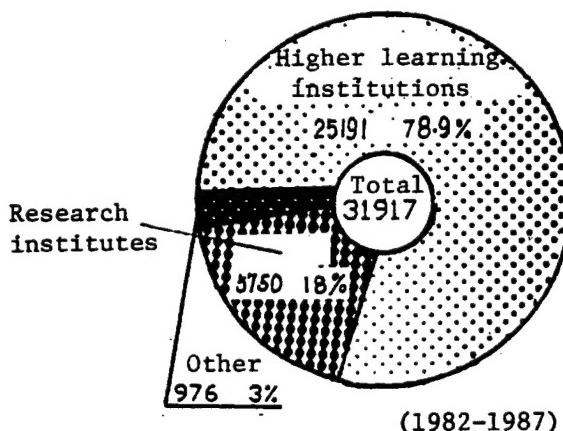
#### A. Funds (10,000 yuan):



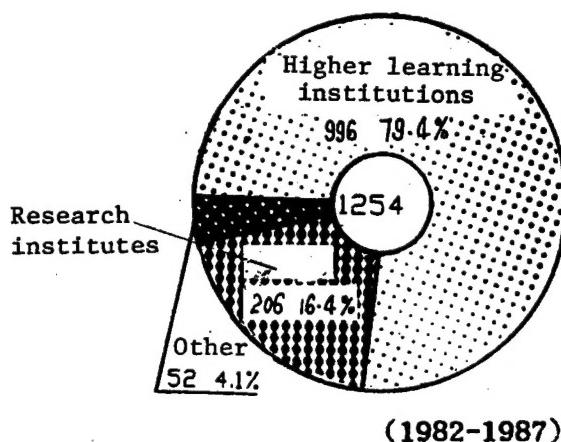
#### B. Projects:



#### A. Total number of publications (Unit: volume)



#### B. Distribution of accomplishments (Unit: item)



development and to ensure the stable progress of basic research. The National Natural Science Foundation established a completely different operating mechanism to manage basic research. This is done to overcome isolationism and to promote technical advances and to train and discover talents.

In the past 3 years, some projects are supported by the National Natural Science Foundation from unsolicited applications and others are organized by the foundation itself. There is an overall plan, as well as an in-depth program. Although there is a plan, however, there is sufficient flexibility. The National Natural Science

Foundation issues an outline of projects every year to point out the directions of applications based on the S&T development plan, worldwide S&T development trend and our emergency needs and selects qualified projects to offer financial support. Special attention is paid to convert technical accomplishments into productivity. It combines the plan from the top down and the applications from the ground up to minimize repetition, waste and mistakes. In addition, it strengthens the review and monitoring of progress in order to reward the good and punish the bad to realize dynamic management. In the review, we insist on the principle of "depending on experts, developing a democratic style,

supporting better projects, being fair and reasonable." Our style is "fairness, rigorousness, efficiency, solid hard work, and service" in order to avoid administrative interventions. The National Natural Science Foundation has made a significant impact on the technical people in China. As our reputation continues to go up, our review is more and more recognized and accepted by the public. The National Natural Science Foundation is being asked to perform technical reviews and assessments by a variety of departments.

The work of the National Natural Science Foundation has received the concern and support of the Party Central, State Council, and a variety of departments and the vast number of technical people. The accomplishment of the National Natural Science Foundation is an indication of the party's success to provide guidance to scientific affairs. However, we are still in a start-up stage. There is a long way to go and the work will be more difficult in the future. We are facing many difficulties, including a lack of funds. Many problems need to be resolved and perfected. Nevertheless, under the guidance of the spirit of the 4th Central Committee Meeting of the 13th Plenum, we are confident that we can do better. In view of the fact that basic scientific research is not compatible with the socioeconomic status of the country, we feel a tremendous responsibility and pressure on our shoulders. We must work cautiously and modestly to

perfect this science foundation with Chinese characteristics and make contribution to the development of basic research and to enhancement of national self-respect and recognition through economic growth stimulated by scientific research.

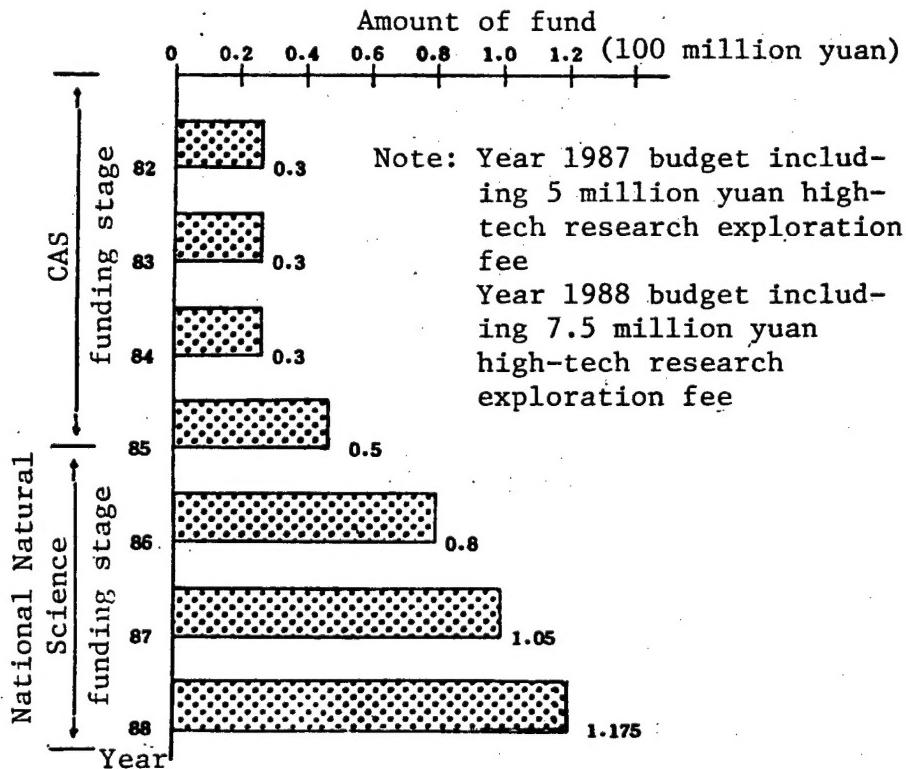
#### Interview With Delegate to WIPO Conference on Intellectual Property Rights Protection

*90CF0135A Beijing ZHONGGUO DIANZI BAO in Chinese 24 Oct 89 p 3*

[Article by Reporter Li Qiongrui [2621 8825 3843]]

[Text] This May, the World Intellectual Property Rights Organization (WIPO) hosted an international conference convened in Washington D.C. to conclude a treaty protecting intellectual property rights as regards integrated circuits (IC's). Formal delegations from 70 countries and the European Community attended the conference. Kuwait, 4 international governmental organizations and 23 international non-governmental organizations also attended the conference through observers. As a result of all manner of effort and discussion, the conference was endorsed by 49 countries (primarily, China and the other developing countries, the Soviet Union and East European Bloc) and opposed by two (the United States and Japan), with five countries abstaining (primarily Sweden, Switzerland and Canada).

Yearly Distribution of Fund



Finally, a treaty text was passed. After passage of the treaty, 51 countries including China signed the conference's final document. According to the terms of the treaty, implementation of this treaty will begin in May 1990, after completion of signing. Protection of intellectual property rights is a novel thing to a great many people, particularly as far as those engaged in developmental research on IC's and the technical managers of industries are concerned. Therefore, this reporter interviewed a consultant to the Chinese Government delegation which attended the conference, Beijing University Professor Wang Yangyuan [3769 7122 0337]. Professor Wang was asked to answer key questions regarding IC intellectual property rights.

**Reporter:** What are the primary objects of protection under the IC intellectual property rights treaty?

**Wang Yangyuan:** This treaty, in the main, obligates each signatory to ensure intellectual property rights protection within their territory to IC wiring-diagram designs (topological diagrams) in accord with the treaty. The primary objects of protection are layout designs of an original nature. This type of design refers to that which is the product of its creator's own intellectual labor; moreover, during creation, the layout design and the manufacturing of the integrated circuit are not of conventional design. At this point it is necessary to give accurate definitions for "integrated circuit" and "layout designs." "Integrated circuit" refers to a type of products which in its final or intermediate forms uses many components, including at least one active element, interconnected in part or completely, assembled within or on the surface of a piece of material to perform a certain electronic function. "Layout design" [i.e., "wiring-diagram design"] refers to the many components of an IC, including at least one active component and the 3-dimensional interconnections between it and part or all of the electronic circuit. Alternatively, it refers to the preparation of this kind of 3-dimensional arrangement for the purpose of manufacturing an IC.

**Reporter:** With regard to the range of protection, what terms are included in the treaty?

**Wang Yangyuan:** Protection is provided insofar as without the consent of the person holding the rights, the protected layout designs of IC's cannot be duplicated wholly or in any part, regardless of whether or not they are combined in an IC. Furthermore, without the consent of the person holding the rights, IC's with protected layout designs cannot be imported, sold, or supplied and marketed by other means for commercial purposes. However, with respect to layout designs with similar principles independently created by third parties, the holder of rights cannot exercise those rights. Even though the permission of the rights holder has not been obtained, use for private purposes or by individuals for evaluation, analysis, research or instructional purposes should not be construed as illegal.

**Reporter:** Are there time limits to the protection?

**Wang Yangyuan:** Prior to the entry of a layout design into common commerce in a particular area of the world, either in itself or as a component of some IC, any treaty signatory has the option not to protect this design. Upon commencement of protection, the time limit is 8 years.

**Reporter:** Must China also formulate a corresponding type of protection law?

**Wang Yangyuan:** It appears that internationally, a policy of intellectual property rights protection is imperative. China must follow the reform. If the road to opening-up [to the outside world] is to be taken, the demands of opening-up internationally must be met, international activities and exchange should be actively undertaken and appropriate laws and regulations formulated. On the one hand, international responsibilities should be assumed, while the fruits of China's intellectual labor should be protected through legislation. Of course, ratification of whether or not to formulate this type of protection law ultimately must pass through the Government's leadership departments.

**Reporter:** Will implementation of intellectual property rights protection affect China's development of IC's?

**Wang Yangyuan:** There are always two aspects to a matter. On the one hand, concerning those intellectual property rights which are protected, the treaty signatories must undertake responsibility for not being able to directly copy or duplicate for commercial purposes; otherwise, the holder of the rights has the right to demand legal recourse. On the other hand, the fundamental achievements of China's intellectual labor can also receive protection under the treaty. Rights and responsibilities are two equal opportunities. This benefits the adaptation to the requirements of opening-up internationally and the development of this country's IC technology and industry.

#### Officials on Role of CAS in Science, Economy 40101006a Beijing XINHUA in English 12 Dec 89

[Text] Over the years, members of the Chinese Academy of Sciences (CAS) have put forward a wide variety of suggestions and recommendations to the state on developing the country's science, technology and economy.

Founded in 1955, CAS's divisions of mathematics and physics, chemistry, geosciences, technological sciences and other disciplines comprise China's highest advisory body for the formulation of science policy. The divisions now have some 300 members, all playing important roles in research institutes, education, health and defense departments, and economic sectors throughout the country.

To boost the development of China's high technology, Professor Wang Daheng and some other CAS members suggested in early 1986 that the state formulate a strategic plan. Several months later, the State Council approved the National High-Tech Development Plan.

The state has also adopted the scientists' suggestions in making China's Seventh (1986-90) and Eighth (1991-96) Five-Year Plans for the development of science and technology.

CAS members have also provided advice for China's economic construction. Members from the division of geosciences recently forwarded a plan for developing nuclear power plants in Southeast China so as to relieve the region's energy shortage. The plan was highly praised by relevant departments of the State Council. In recent years, some 100 members of the division have also conducted deep research involving the harnessing of the 750,000-sq-km Yellow River valley, one of the most important tasks in the region's industrial and agricultural development. The report they submitted to the State Council has led to part of a program in the state's Eighth Five-Year Plan, according to which the region will become one of China's biggest bases for the grain, cotton, energy and chemical industries.

In 1981-87, CAS members, including the leading scientists Xie Xide and Ma Dayou, urged the founding of a national fund for natural sciences to secure the development of China's basic sciences. CAS established such an organization in 1982, based on which the State Natural Sciences Foundation Committee was set up in February 1986. A CAS official said the foundation has provided support for scientific research and made the limited money go further in research. In order to give full scope to CAS members, the CAS official said, the headquarters of the academy is to strengthen its management of divisions and to allot more funds for the work of the members.

#### **CAS President Previews Activities for Coming Decade**

*40101006b Beijing XINHUA in English 15 Dec 89*

[Text] In the coming decade, the Chinese Academy of Sciences (CAS) will strive to form more high-level scientific centers in emerging disciplines to help solve more problems in China's social and economic development.

Zhou Guangzhao, president of the academy, said here today that the CAS will work on China's long-term, complex problems in science and technology and will continue to support the application and development of high technology. He said that the CAS will set up a number of laboratories and strengthen international exchanges and cooperation.

In the coming decade, Zhou said, the CAS expects that research will bear fruit in such fields as high-temperature superconductors, particle physics and synchronous radiation, nuclear radiation, surfacial and interfacial physics, solar-earth physics, molecular and cytobiology, global climate changes, evolution and the formation of the lithosphere. The CAS will also help boost research on the nervous system, non-linear science and robotics.

Zhou said that the CAS will conduct systematic inspections of various resources for social and economic development and research involving mid- and long-term forecasting of natural disasters, and will set up an environmental monitoring network. In addition, he said, the CAS will strengthen its efforts to increase agricultural production and improve plant strains since agriculture remains an urgent task.

According to Zhou, the CAS will build research and development centers in some important areas, such as natural gas engineering, new materials, bio-technology, marine science, microelectronics, communications networks, computer science, and laser technology. He said that the CAS will also focus on speeding up the process of applying research achievements in industry.

#### **China Seeks More Food, Other Gains from Hi-Tech**

*40101007a Beijing CHINA DAILY in English 29 Dec 89 p 1*

[Article by Gu Chengwen, staff reporter]

[Text] China is pinning its hopes for feeding its rapidly growing population on breakthroughs in biotechnology, such as breeding new plant and animal varieties, according to government sources.

By the year 2020, the population is expected to be about 1.5 billion, and producing enough food for such a huge population will be a major problem, said sources with the State Science and Technology Commission.

That is why biotechnology was put at the top of the list of the "863" (March 1986) program, China's high-tech research and development plan for the 21st century.

The sources said that under the plan, marked progress has already been made in growing rice. In early experiments, hybrid rice sub-species in double-crop plantings have yielded 20 percent more rice than by the traditional farming methods. More acres will be planted this way, and if the rest of the experiment is successful and is adopted nationally, China will increase its rice output by 100 million tons a year, the sources say.

They said achievements have also been made in other areas of the program.

The "863" program covers such areas as biotechnology, space technology, information, lasers, automation, energy and new materials. The sources said these areas in turn have been divided into more than 100 sub-areas and about 1,000 subjects, involving 500 institutes and schools and 10,000 scientists.

To concentrate funds on the most important projects, some high-level research centers have been established, such as those working on optoelectronics and computer integrated manufacturing systems.

Various feasibility studies have been made over the past two years, general designs have been drawn up and a research network has been established.

For example, the automation area is divided into computer systems and "intelligent robot" divisions, and the latter is attempting to develop three types of products

that will work in certain environments, such as in the nuclear industry, underwater projects and high precision assembly jobs.

The sources noted that the State will increase its investment in the program year by year, and will absorb more top level scientists into it.

**Symposium on Chemistry, Pharmacology Planned**  
**40101004a Beijing XINHUA in English 15 Dec 89**

[Summary] The second Sino-Brazilian symposium, organized by the Oswaldo Cruz Foundation and sponsored by the governments of China and Brazil, is scheduled to be held in China in 1993. Attendees will include researchers from China and Brazil, as well as from other countries in Latin America, Africa and Asia, and will discuss such issues as the therapeutic values of natural products found in China and Brazil.

**First Soft Science Research Center Established**  
**40101004b Beijing DOMESTIC SERVICE in Chinese**  
**4 Nov 89**

[Text] The first soft science research center of China was recently set up at the University of Science and Technology for National Defense. Soft science is a new branch of comprehensive learning and mainly includes the sciences of systems, management, scientific knowledge, the future, technology and economics. The research center may provide scientific bases for some of China's decision making involving national defense and national economic construction after its establishment.

### Details of F8, F8-II Advanced Fighters Presented

90CF0092 Beijing HANGKONG ZHISHI  
[AEROSPACE KNOWLEDGE] in Chinese No 10, 6  
Oct 89 pp 8-10, 32

[Article by Zhou Rixin [0719 2480 2450]: "Advanced Fighters Designed by China; From F8 to F8-II"]

[Text] Since the founding of the Chinese Communist government 40 years ago, China's aerospace industry has grown to a considerable size, from repair and developing copies to original design. It has been a difficult process. Among all the accomplishments, the independently designed F8 fighter series has particularly attracted a great deal of attention.

After several years of serious preparation and deliberations, China's aerospace industry unveiled the prelude to the development of new high-altitude, high-speed fighters. In May 1964, in the new aircraft improvement program conference, the Aeronautics Research Institute proposed to design a more advanced fighter based on the MIG-21. In October of the same year, new fighter designs began. The Shenyang Aircraft Design Institute presented two layouts, one with a single engine and the other with two engines. The former was a plan which required the development of a new high-thrust engine and the latter involved modification of a mature engine. Under the leadership of Tang Yanjie [0781 1693 2638], director of the Aeronautics Research Institute, it was decided to adopt the twin-engine design. This was a correct choice. It was prudent and reliable to do so because there was sufficient technical basis. This was the premise for the successful development of the F8.

### Approval To Develop the F8

On 17 May 1965, Chief of Staff Luo Ruiqing [5012 3843 0615] approved the strategic and tactical specifications of the new fighter and the development project. The aircraft was called the F8. The development work was primarily carried out by the Shenyang Aircraft Design Institute and the Shenyang Aircraft Manufacturing Plant.

The leadership was very concerned about the development of the F8. On 14 August 1965, during a status report on the development of the F8 in Shenyang, Vice Premier He Long [6320 7893] instructed that "the F8 must be completed as soon as possible." On 18 August, in his letter to Deputy Chief of Staff Zhang Aiping [1728 1947 5493], Marshal Nie Rongzhen [5119 2837 5271] described several problems that had to be taken into consideration in the design of the new aircraft in detail. It provided the guidance necessary for the development of the F8.

### Special Features in the Development Plan

The F8 development plan focused on higher altitude, higher speed, longer cruising range, faster climb rate, and heavier firepower. Each item was improved to correct

the deficiencies of the F7. Every specification was enhanced: 1) maximum speed: Mach 2.2; 2) maximum altitude: over 20,000 meters; 3) maximum rate of climb: 200 meters per second; 4) basic range: 1,500 kilometers, maximum range: 2,000 kilometers; 5) combat time at 19,000 meters specified; 6) modified guns and air-to-air missiles installed; 7) longer range radar installed.

The air intake is at the nose of the F8. Its aerodynamic configuration includes large sweep angles, a small aspect ratio, thin delta wing, a low, flat tail, and a pair of ventral strakes. It uses two 7A turbojet engines. The thrust-weight ratio of the aircraft is 0.89, better than that of the F7.

### Full-Blown Design

In September 1965 full-blown design work for the F8 began. Since the tragic death of Chief Designer Huang Zhiqian [7806 1807 0578] in an airplane accident abroad in May, Ye Zhengda [0673 2398 1129] was in charge of the technical aspect of the development work. The Chief Designer's Office, headed by Wang Nanshou [3769 0589 1108], handled the specific organization work. In December, a wooden model of the F8 passed a review. At the end of March 1966, designers arrived at the plant to work with the workers and technicians on site. By the end of 1966, a complete set of drawings for the aircraft was released. In early 1967, production documents were issued to the factory to begin pilot production.

In the aerodynamic layout of the aircraft, Associate Chief Designer Gu Songfen [7357 6139 5358] and the designers came up with several schemes. They conducted a large number of wind tunnel experiments in order to make prudent selections. Major technical issues such as the supersonic directional stability of the aircraft, positions of the horizontal tail and vertical tail, etc., were resolved.

During the on-site design period, over 570 designers led by Wang Nanshou together with over 80 experienced workers such as Chen Ayu [7115 7093 3768] and Wang Ahui [3769 7093 1920] and more than 30 technicians worked hand in hand to discuss various design schemes and to proceed with paper design. During this period, the technicians and workers proposed 2,330 opinions for improvement and 1,660 of these suggestions were adopted, including 40 major improvements which further improved the manufacturability of the aircraft. For instance, a scheme to eliminate the bearer of the main wing spar was realized after the concept was proven experimentally with the assistance from the workers and technicians using a MIG-21 spar. This improvement changed the traditional MIG structure and reduced its weight by 4 kg.

One of the design difficulties was the ammunition delivery system. It must guarantee continuous firing of the gun in the air. Experts in other countries thought that they had a monopoly on that system. During the development process, the designers conducted experiments

with the workers and ran 10,000 blank rounds through a modified gun. Finally, they figured out a pattern to arrive at a successful design.

### Test Flights Begun

Preparation for the pilot production of the F8 began in the second half of 1965 at the Shenyang Aircraft Plant. Under the leadership of First Deputy Director and Chief Engineer Gao Fangqi [7559 2455 0796], Deputy Chief Engineer Luo Shida [5012 2514 1129] was put in charge to draw up the overall plan for the F8. This plan was drawn up based on experience gathered in the USSR and UK. It adopted a novel technique coordination method which involved the use of a drawing on a clear plastic sheet as the basis to be coordinated with optical instruments, assembly machines, scribes, and drill presses, partial gages, and partial models. It was proven later in practice that from the fabrication of over 100 sub-assemblies from more than 11,400 parts and 1,200 standard components, to the alignment of front and rear fuselage sections and mating of fuselage and wings, and to the installation of engines and fuel tanks, it was essentially done successfully in the first trial. The new method also significantly reduced the pieces of equipment required and accelerated the pilot production process.

Just as the development was progressing smoothly, Gao Fangqi died of illness on 29 January 1966. The Ministry of Aerospace Industry sent Liu Hongzhi [0491 7703 1807], who was director of Shenyang Institute of Aircraft Design, to take over the job as first deputy director and chief engineer of Shenyang Aircraft Plant concurrently. He was put in charge of the on-site design and overall development of the F8. In November 1966, Liu Hongzhi was unfairly treated in the "Cultural Revolution" and was forced to stop working. The plant and the institute jointly formed a command center for the development of the F8. Deputy Plant Director Wang Xin [3769 2450] was in charge of the overall operation. Both plant and institute personnel supported each other and created an excellent working atmosphere.

In January 1967, the production schedule was severely impacted by the "January Storm," a violent power struggle in the cultural revolution. Production lines almost came to a complete halt. The large number of technical staff and workers risked their lives to go to work. Even in July and August, when fighting was most violent, the F8 development work did not stop. In July 1968, the first two F8's were completely assembled.

### First Trial Flight Successful

On 5 July 1969, the first trial flight of the F8 took place. At 9:30 am, test flight commander, Air Force Deputy Commander Cao Lihuai [2580 6849 2037] ordered the plane to take off. Pilot Yin Yuhuan [1438 3768 3562] flew the F8 over the airport twice and landed it safely. People at the airport applauded and loudly cheered the

successful development of the first high-altitude, high-speed fighter that China had designed and manufactured independently.

From demonstration of feasibility to test flight, the F8 went through numerous stages, including overall layout, technical design, wooden model and review, release of drawings, manufacturing of aircraft, and static force test. It took 4 years and 10 months. It was no accident that things happened at a relatively fast pace. It was due to the following reasons:

It began on a solid footing. The F8 design work was based on 3 years of "technical understanding" of the MIG-21 and on foreign aircraft technology. The design scheme included both advanced features and traditional features. Furthermore, it was compatible with the industrial level and technical condition in China.

The right technical decisions were made. Sufficient technical work had been done to prove the selection of engine, air intake mode, and ejection method. The turbojet-7A engine used by the F8 was developed based on turbojet-7 by switching to a high temperature turbine. As a result of joint efforts by related organizations in the aerospace industry, Chinese Academy of Sciences and metallurgy industry, the first batch of engines were made in 1968 to guarantee a smooth flight.

People were motivated and collective wisdom was fully utilized. During the development process, we combined research, production and application, as well as leadership, workers and technical personnel. Everyone was dedicated to the development of the F8 and various technical problems were solved satisfactorily at a fast pace.

The organization provided good leadership. The Ministry of Aerospace Industry organized the entire industry to give the go-ahead to the development of the F8. All relevant departments cooperated fully and established a test flight leadership group. The Ministry of Aerospace Industry and the Aerospace Research Institute established a joint command center. Shenyang Aircraft Plant and Shenyang Institute of Aircraft Design created an on-site command post to organize resources to solve 23 problems affecting the first flight. Deputy Air Force Commander Cao Lihuai was also instrumental in taking decisive measures when he was in charge of the test flight.

Test flights were continued to tackle key problems. The chaos created by the cultural revolution severely hampered the development of the F8. After the first test flight, the test leadership group and joint command center were dissolved. The Chief Designer's Office was eliminated. All rules and regulations were destroyed. Technical leaders such as Wang Nanshou, Gu Songfen and Feng Zhongyue [7458 6988 6390] were barred from working. The progress of the F8 development was repeatedly hindered, and for a while stalled. Despite this extremely difficult situation, employees of the aerospace industry fought with their best efforts to protect the F8 from being trashed.

Test flights are important to the development of a new aircraft. Test flights determine the technical performance, manufacturing quality, operating characteristics of accessories, and operation and maintenance properties of the new aircraft. They expose problems to be resolved to perfect the aircraft design. This is a necessary step to finalize the design of a new aircraft. In the long 10-year period, 663 flight hours and 1,025 takeoffs and landings were accumulated in the airfields at the institute and the plant. A series of technical problems had been solved and a number of key technical hurdles were overcome.

1. Transonic and supersonic vibration was eliminated. In 1969, the F8 encountered very intense transonic vibration at Mach 0.86 and the aircraft could not exceed the sound barrier. Gu Songfen personally conducted high-speed wind tunnel oil flow tests and ground harmonic tests. Test pilot Lu Mingdong [7120 7686 2639] assisted the designers to find its cause. He repeatedly risked his life to fly the aircraft. It was finally determined that the vibration was caused by turbulence. Measures were taken to solve the problem. However, 8 years later, vibration occurred again as the aircraft passed the sound barrier. Again, Gu Songfen worked with pilot Lu Mingdong. He rode on a supersonic training plane piloted by Lu Mingdong to track the F8 and took pictures of the flow pattern around its tail. This further determined the flow separation region and pinpointed the cause of vibration. Finally, the tail pattern was partially modified to eliminate this flow separation and thoroughly solved this key technical issue. The supersonic flutter of the F8 occurred at Mach 1.24. An analysis showed that it was caused by the booster system. After reviewing foreign aircraft designs, the design personnel at Shenyang Institute of Aircraft Design designed a new damping cone to be installed on the rudder to eliminate this supersonic vibration.

2. Rear fuselage high temperature was solved. The fact that temperature on the rear fuselage of the F8 was running high at high altitude and high speed was initially discovered in 1970. Then, forced cooling measures were taken to fix the problem on a preliminary basis. In 1976, after long periods of high-speed flight, the drag parachute and parachute compartment were burned out due to excessive temperature. A task force was organized to take a combination of measures to insulate, cool, shock mount and partially replace materials on the aircraft and the engine. Afterwards, no abnormality was found even after long periods of time of high-speed flight at high altitudes. The rear fuselage high temperature problem was completely solved.

3. Engine shutdown in mid-air was addressed. Engine shutdown in mid-air happened three times prior to 1976. It was temporarily fixed with the installation of a throttle stop card. In October 1976, three more mid-air engine shutdown incidents took place in a row. Because of these incidents, the Ministry of Aerospace Industry established a technical leadership task force in January 1977. Effective measures were implemented to improve the

aircraft and the engine in order to thoroughly solve this mid-air shutdown problem. This accomplishment was given a second place technical achievement award by the Ministry of Aerospace Industry.

During the process of finalizing the design and attacking key technical issues, test pilots Lu Mingdong, Hua Jun [3323 0193], Wanh Ang [3769 2491] and flight commander Su Guohua [5685 0948 5478] cooperated with the technical staff and made significant contributions.

#### Finalizing the F8 Design

In September 1978, the Shenyang Institute of Aircraft Design officially restored the Chief Designer's Office and appointed Gu Songfen as the chief designer. On 31 December 1979, the Aerospace Product Design Finalizing Committee agreed with the final F8 design. On 2 March 1980, the State Ordinance Product Design Finalizing Commission officially approved the design (see Figure 1).

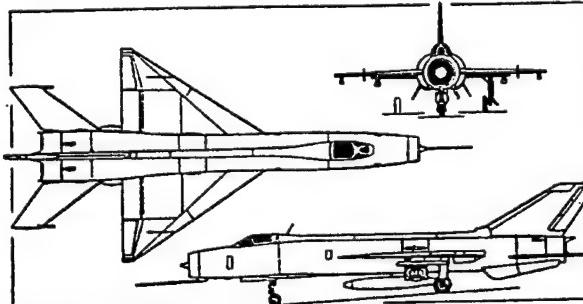


Figure 1. The F8 From Three Sides

Technical data: wing span 9.344 m, length 21.52 m, height 5.41 m, wing area 42.187 m<sup>2</sup>, normal takeoff load 13,850 kg, maximum level airspeed (high altitude) Mach 2.2, practical ceiling 20,500 m

It took 10 years for the F8 to move from test flight to final design. In addition to the interference due to 10 years of chaos, lack of experience in the development of a new aircraft, and underestimation of its degree of difficulty was also an important factor attributing to the slow progress. This was also reflected in the development process. There was not enough research and experimentation. Key technical issues were not studied ahead of time. Instead, they were studied and conquered in the sky. Next, the development of a new engine, new airborne equipment, new techniques, and new materials were not undertaken in coordination with the rest of the aircraft. Rather, they were causing conflicts along the way. Third, we did not have good control over the test flight protocol for a new aircraft. There were too few planes for test flights and the funding was insufficient which lengthened the test flight cycle. Fourth, the technical and administrative command systems were changed repeatedly, especially in the middle of the development process. It was impossible to effectively command, dispatch, and coordinate the development progress of the F8.

### Development of the F8-I

The F8-I is an all-weather aircraft. Compared to day-time aircraft, improvements have been made in three areas, i.e., installation of 11 pieces of electronic equipment, including a fire control radar, redesigned canopy, seat, oxygen system, and combination instrumentation, and revamped weapons to include a 23-III aircraft cannon, four "PL-2B" guided missiles, and four sets of rockets.

Shenyang Institute of Aircraft Design released a complete set of production drawings for the F8-I in February 1978 and Shenyang Aircraft Corporation (i.e., originally Shenyang Aircraft Plant) immediately began pilot production. The first aircraft was completely assembled in May 1980.

On 25 June, as we prepared to proceed with ground testing, a major incident happened. In the first test run, the engine caught fire within 20 minutes and burned up the aircraft. The loss was not only costly but also further delayed pilot production.

The incident was analyzed, investigated, and tested. It was found that the direct cause was due to a ruptured hydraulic line and hydraulic fluid was sprayed onto the engine.

The hydraulic system of the F8-I was switched to the YB-20B pump. The factory tested it on the ground and concluded that the dynamic pressure at the exit was under the specified value. It was considered acceptable. However, this test was not repeated based on actual flight condition. An experiment conducted after the incident showed that when the engine was running at 0.8 of its specified rotation speed, the dynamic pressure pulse frequency of the pump matched that of the pipe to lead to resonance. This led to a rapid increase of the pulse pressure inside the pipe to cause it to burst.

This incident taught us a good lesson. Once again, it demonstrated that science is a solid discipline that does not allow us to cut any corners. The design of a new aircraft must have a comprehensive test protocol. Ground simulation tests must be carried out as close to real conditions as possible, otherwise serious consequences may result. In order to eliminate the design defect that caused the incident, Shenyang Institute of Aircraft Design decided to use the 2B-34 pump. Shenyang Aircraft Corporation organized its entire employees to assemble another F8-I at the highest quality and at the fastest time possible. On 24 April 1981 this plane took off under the control of pilot Lu Mingdong. In October, the second F8-I took off. In July 1983, the entire aircraft went through static destruction test and was found to meet design requirements.

The F8-I aircraft was tested for performance, for electronic equipment such as radar and weapon system, and for certain key issues. It lasted 3 and a half years and was completed in November 1984. The Model 204 onboard radar was developed jointly by relevant plants under the jurisdiction of the Ministry of Electronics Industry and the Ministry of Aerospace Industry. After 90 takeoff and

landing cycles, its major characteristics had reached or exceeded the original specifications.

### Finalizing the F8-I Design

On 27 July 1985 the Aerospace Product Design Finalizing Committee officially approved the final design of the F8-I. From inception to final design the total cycle was a little over 8 years, much shorter than that for the initial F8 design. This is because the F8-I was developed during a stable political and economic period. Moreover, the entire technical team had been trained by the F8 development process and had acquired experience. In particular, effective leadership was provided in the test flight of the F8-I. Four aircraft were engaged in the test flight program simultaneously. This was a valuable experience in speeding up the development of a new aircraft.

The successful development of the F8 and F8-I sent out a signal that fighters designed by China had reached a new level. In October 1985, upon approval of the national science and technology progress review committee, outstanding national science and technology progress awards were granted to Gu Songfen, Wang Nanshou, Ye Zhengda, Luo Shida, Zhao Peilin [6392 3099 7207], Fang Wenfu [2455 2429 1381], Lu Mingdong and Zhu Kexin [2612 0344 2500].

### Presentation of the F8-II Assignment

Since the late 1970's, a new trend has emerged for fighters under development. People were no longer after high speed and altitude. Instead, efforts were made to improve the maneuverability in middle and low altitude and to perfect the airborne electronic equipment, weapons and fire control system. In the past decade, in regional conflicts most air combat activities involving supersonic interceptors took place in low and mid-altitude at near sonic speed. Air combat demands excellent maneuverability, i.e., turning, acceleration, deceleration, and climbing characteristics. Both guns and missiles are important weapons.

In order to revamp installed equipment and raise combat readiness, China's aerospace industry began to track the development trend of fighters in the early 1980's. In marching toward a higher level it began to develop the F8-II, which as world-class characteristics (see Figure 2).

The F8-II was developed based on the F8 with several major improvements. The key area of improvement is the weapons and fire control system, the airborne electronic equipment, and the power device. The air intakes are located on both sides which provides space for installing a larger aperture radar. It switched to two 13A turbojet engines for more thrust to improve maneuverability at mid and low altitudes. External stores were added to hang more weapons to allow the aircraft to perform both all-weather air interception and ground attack. The overall changes added up to over 70 percent compared to the original F8. Approximately one-third of the aircraft is new products.

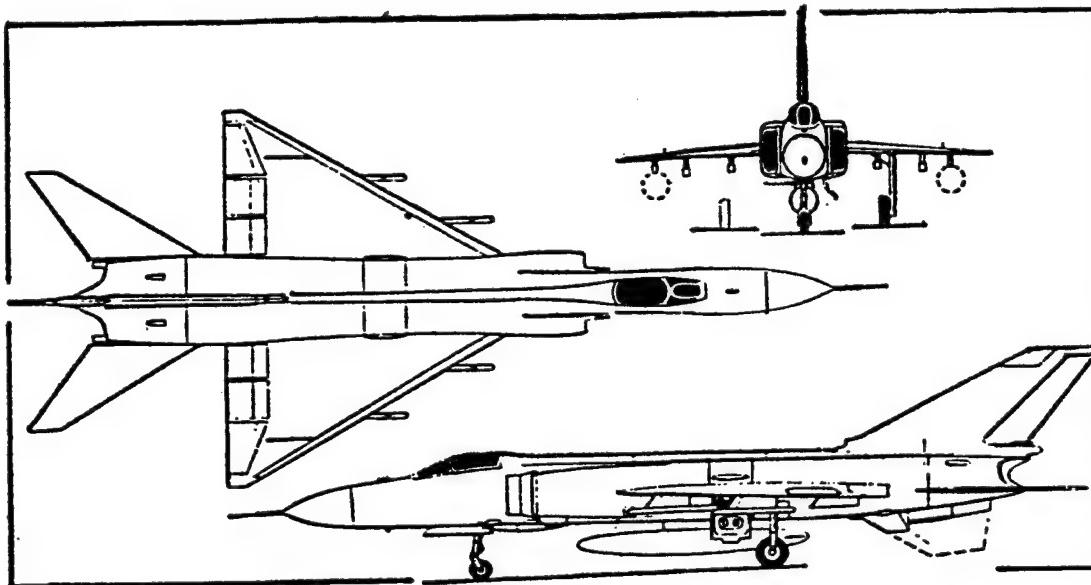


Figure 2. The F8-II From Three Sides

Technical data: length 21.59 m, wing span 9.344 m, height 5.41 m, wing area 42.2 m<sup>2</sup>, gross weight 9,820 kg, normal takeoff load 14,300 kg

#### Development of F8-II Approved

In September 1980, the government approved the major tactical and strategic objectives of the F8-II. Feasibility of the scheme was demonstrated and the overall plan was nailed down in April 1981. The assignment was given to the Shenyang Institute of Aircraft Design and the Shenyang Aircraft Corporation.

Systems engineering management was employed in the development of the F8-II. Under the leadership of He Wenzhi [0149 2429 3112], general commander of the development effort and vice minister of the Ministry of Aerospace Industry, feasibility was demonstrated in terms of technology, economics, and scheduling. A chief designer technical responsibility system, an administrative command responsibility system, an economic contract responsibility system and a quality inspection responsibility system were established to manage technology, economics, progress and quality. In system engineering management, the chief designer system headed by Gu Songfen played an important role. Technically, a four-tier responsibility system consisting of the chief model designer → chief system designer → head designer → designer in charge. The work was clearly divided and responsibility concisely specified. The administrative command system has the authority to give orders at will. Shenyang Aircraft Corporation Manager Tang Gansan [0781 0051 0005], Assistant Manager and worksite commander Guan De [4619 1795], and Chief Engineer Gu Yuanjie [7357 0337 2638] effectively provided the leadership. The chief accountant system issued fixed cost contracts which effectively took advantage of the economic leverage. Quality management penetrated the entire process and design quality check was well under

control. These measures ensured smooth progress in aircraft development. Because everyone worked very hard, every sub-system, every item and every procedure was completed on schedule.

The Shenyang Institute of Aircraft Design began the technical and structural design work in 1982. In May 1983 a complete set of drawings were released. By the end of May 1984, 39 wind tunnel experiments had been completed. Fifty-eight structural and system tests and 25 static force tests were also completed.

The Shenyang Aircraft Corporation began installing equipment and manufacturing parts in 1983. It took 17 months for the aircraft to be fully assembled and for the first test flight to be successfully completed.

It took Guizhou Institute of Engine Design, Guizhou Engine Corporation and Chengdu Engine Corporation only 3 years to develop and deliver the 13A turbojet engine for the first aircraft.

All finished accessories essentially met the needs of the aircraft.

#### Successful First Flight of the F8-II

On 12 June 1984, the first test flight of the new F8-II was successfully made by test pilot Qu Xueren [2575 1331 0088].

In the past three decades, China has developed and produced several fighter models. We are working on more advanced fighters. Before the end of this century, a

new generation of high-performance fighters will be developed to equip our armed forces in order to modernize our national defense.

### Feature on Long March 2E Launch Vehicle

*90CF0074A Tianjin ZHONGGUO JISHU SHICHANG BAO [CHINA TECHNOLOGY MARKET NEWS] in Chinese 6 Sep 89 p 4*

[Article by Yin Huaiqin [1438 2037 0530]]

[Text] China began development of the Long March 2E launch vehicle in 1986. The power plant of the Long March 2E is developed from the well-known Long March 2 rocket augmented with four strap-on boosters. With conceptual design, preliminary design and structural design completed, the launch vehicle is now in the production stage.

The Long March 2 launch vehicle is a two-stage rocket 32 m long and 3.35 m in diameter; it has a lift-off weight of approximately 190 tons, with a lift-off thrust of 280 tons. It uses nitrogen tetroxide and unsymmetric dimethyl hydrazine (UDMH) as propellant. Between 1975 and 1988, this rocket successfully launched 11 retrievable satellites, and its launch services are marketed internationally. After 1990, it is estimated that nearly 100 large-capacity, long-design-life and low-cost communications satellites will be launched worldwide; these satellites will require a launch vehicle that can carry a payload of 2.4-3.2 tons into a transfer orbit. Currently, China has no rocket with such capability. In order to satisfy the needs of the world launch market and to expand China's market share, we must develop a launch capability for injecting a payload heavier than 2.5 tons into a transfer orbit. It is quite clear that a simple way to achieve this goal is to augment the thrust of the technologically mature Long March 2 rocket.

The main design features of the Long March 2E launch vehicle consist of the following: the first- and second-stage propellant tanks of the Long March 2 rocket are lengthened by 10 meters, and four liquid-propellant boosters are strapped around the first-stage rocket engine; a flight-certified payload spin system and attitude-control system are added in accordance with user requirements; also, a new fairing is installed to cover the payload. However, the overall structure is essentially based on the mature design of the Long March 2 and Long March 3; it consists of four segments: the propellant tank, the inter-stage segment, the instrument compartment, and the payload fairing.

The Long March 2E launch vehicle is 51 m long; its core diameter is 3.35 m and the booster diameter is 2.25 m. The four booster rockets are liquid-propellant engines identical to the first-stage engine. The lift-off weight of the Long March 2E is approximately 462 tons, and its lift-off thrust is 600 tons. It is capable of launching an 8-8.8-ton payload into a low-earth parking orbit, i.e., it can perform the task of a space shuttle. Specifically, it can carry a communications satellite equipped with a

perigee motor (upper stage) into a parking orbit, where the perigee motor is activated to inject the satellite into a transfer orbit. The altitude of the parking orbit is approximately 200 km, and the apogee altitude is approximately 35,800 km. When the satellite reaches apogee altitude, the apogee motor is ignited by ground command, and sends the satellite into a geosynchronous orbit located at a pre-designated station.

It should be pointed out that the 8-8.8-ton payload includes the satellite and the perigee motor with a weight ratio of approximately 1 to 2, i.e., the satellite weight can be 2.67-2.93 tons. For a high-performance perigee motor, this ratio can be 1 to 1.5, i.e., the satellite weight can be 3.2-3.52 tons. This capability satisfies the needs of the satellite launch market of the 1990's.

For this reason, several foreign companies have expressed interest in a cooperative effort to launch their satellites using the Long March 2E.

For example, in mid-1991 and early 1992, respectively, the Long March 2E will launch two second-generation Australian satellites of the AUSSAT-B type.

### Laser NDT System Unveiled at Xian Aircraft Institute

*90CF0074B Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 36, 20 Sep 89 p 20*

[Article by Wang Bin [3769 2430] and Yang Fan [2799 0028]]

[Text] A multi-functional laser non-destructive testing (NDT) system designed to automatically monitor aircraft engine operation was recently developed by Plant No 7416 of the Xian No 4 Institute under the Ministry of Aeronautics and Astronautics Industry (MAAI). The system is now in batch production.

In an effort to improve the reliability of engine operation and to enhance aircraft performance under adverse weather conditions, Plant No 7416 of MAAI began development of a multi-functional laser NDT system by incorporating state-of-the-art technologies and by examining the unique features of aircraft engines. After repeated tests and numerous improvements of the system, the development was completed. The system consists of a laser non-destructive detector, an electronic temperature-sensing device, a laser control unit, and an automatic alarm unit; in addition, it uses a microcomputer to monitor the engine operating conditions and has fault-analysis and high-speed camera subsystems. The operational procedure of the system is as follows: under normal engine operating conditions, the laser monitors the engine status and reports it to the control system, which in turn sends a sequence of regular audio signals to the control system; if an abnormal condition is detected, the automatic monitoring unit issues a warning signal so that the operator would be alerted to activate the back-up unit to avoid a potential accident. The high-speed camera can photograph the engine operating sequence

and store the information in a data base which can be used for fault analysis or for future development of new engine models. Technical experts who certified the system generally agree that the system has an innovative design concept and uses state-of-the-art technologies; its picture quality and reliability have been shown to satisfy design specifications. Because of its capability in meeting the tactical requirements of different aircraft models, it will undoubtedly be used on many domestic aircraft.

#### Advances in Airborne Remote Sensing Systems

90CF0074C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 26 Sep 89 p 2

[Article by Huang Yong [7806 0516]]

[Text] Beijing, 25 Sep—As part of the "Seventh 5-Year Plan," significant progress has been made in the development of China's airborne remote sensing technology; in particular, a number of state-of-the-art research achievements have recently been reported in the areas of resource exploration, environment monitoring and disaster forecasting.

A major project of the "Seventh 5-Year Plan" has been to develop a "high-altitude airborne remote sensing system." The Shanghai Technical Physics Institute of the Chinese Academy of Sciences (CAS) has developed China's first integrated airborne remote sensing system, which consists of 10 different types of remote sensors covering the frequency range from visible light to the infrared and microwave bands. The system is comparable in technology to similar systems built by developed nations in the 1980's.

By combining the remote sensing system, the real-time transmission system and the infrared scanner, research institutions of CAS have successfully developed a real-time forest-fire monitoring system. At an altitude of 6,000 m, the infrared detector can detect a ground fire 1 square meter in size, and the image can be transmitted in real time to the ground command station; also, the location of the fire can be quickly calculated, and a map can be generated to indicate its latitude and longitude. In July of this year, an experiment was successfully conducted to transmit all-weather microwave side-looking radar images in pseudo real time; specifically, images of flood conditions around the Changjiang and Jing Jiang region were transmitted via Intelsat to the central command to provide reliable data for planning rescue missions.

During today's news conference, announcements were made on the first successful development of a high-resolution infrared fine-spectrum scanner which can be used in mineral exploration and petroleum exploration, and on the application of remote sensing techniques in forest inspection and protection, ice and snow forecasting, and wheat-crop forecasting. These research products are all considered to be highly advanced in terms of technological standards.

#### Feature on Wind-Tunnel Research

90CF0074D Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 16 Oct 89 p 1

[Article by Yu Zhendao [0151 2973 6670]]

[Text] After 20 years of struggle and hard work, Chinese scientists and engineers have constructed a performance-coordinated wind tunnel complex in southwest China. Over 230,000 tests have been conducted in these wind tunnels for the development of aircraft, missiles, satellites and launch vehicles.

A wind tunnel is a facility where artificial air flow is generated for the purpose of observing flow phenomena and studying the interaction between air flow and test objects; it plays an important role in the development and improvement of aircraft and space vehicles.

According to a spokesman for the Chinese Aerodynamics Research and Development Center, this complex consists of 27 performance-coordinated wind tunnels and various specialized test equipment. It can be used to support preliminary research, design trade-off studies, final design and design improvements. The facilities of this complex that have attained worldwide reputation include: the 8 m x 6 m low-speed wind tunnel used for testing the aerodynamic characteristics of aircraft and for wind loading tests of missiles and rockets; the 1.2 m x 1.2 m transonic-supersonic wind tunnel used for testing aircraft and missile designs; the 0.5-m-diameter hypersonic wind tunnel used for testing missile and satellite designs; the 2-m-diameter shockwave wind tunnel used for aerodynamic tests and aerothermal tests of aircraft and spacecraft under high-speed, high-temperature and high-pressure conditions; the 0.3-m-diameter low-density wind tunnel used to provide simulated test conditions at altitudes of 60 to 110 km; the 200-m free-flight ballistic target used for corrosion tests of spacecraft passing through adverse weather environments and for model-retrieval tests; and the 20-megawatt electric-arc heater for testing heat insulation designs and for ablation tests of insulation materials of re-entering spacecraft.

In the late 1960's, waves of scientists and engineers arrived at the southwest region from Beijing and Shenyang to participate in the wind-tunnel construction project. They lived in tents and drank rain water; they built roads through mountains and cleared land for construction. Carrying out their designs in the wilderness, they built one wind tunnel after another, and in the process more than 140 innovative designs were created. In particular, designs of the 1.2 m x 1.2 m flexible-wall jet nozzle, the 8 m x 6 m wind tunnel and the high-voltage ablation test equipment were awarded the First, Second, and Third Prize, respectively, for outstanding scientific achievement.

These wind-tunnel facilities have been used by the China Aerodynamics Research and Development Center to conduct over 2,400 model tests on aircraft, missiles,

satellites and launch vehicles to provide large amount of data for the development and improvement of more than 70 of China's aircraft and spacecraft. Specifically, the wind-tunnel test of a particular fighter aircraft model provided the clue for solving the mid-air engine-stall problem and allowed the manufacturer to make timely improvements to the more than 40 aircraft on the assembly line to avoid large financial losses; the thermal environment test of a particular missile warhead verified the thermal design of the warhead and ensured the success of China's launch vehicle test toward the South Pacific. They also conducted base-flow thermal insulation tests and pulse-pressure tests of the launch vehicle, and ignition tests and life tests of the satellite attitude-control engines under vacuum conditions to provide valuable technical data for the development of China's communications satellites.

### **Research at Nanjing Aeronautical Institute Highlighted**

*90CF0093A Beijing GUOJI HANGKONG  
[INTERNATIONAL AVIATION] in Chinese, No 10, Oct 89  
pp 6-7*

[Article by Sun Pingsan [1327 1627 0416]: "S&T Research at Nanjing Aeronautical Institute"]

[Text] Nanjing Aeronautical Institute (NAI) is located on the site of the old palace of the Ming Dynasty at the foot of Zijin Mountain east of Nanjing. It has more than 800 mu of land and is an important base for training technical talents and conducting aerospace research in China.

NAI was founded in October 1952. After more than 30 years of hard work, it has become a multi-disciplinary engineering-based university with special emphasis on aerospace. It is one of the first group of higher-learning institutions authorized to grant doctoral and master's degrees in China. There are 12 departments, including aircraft, dynamic engineering, automatic control, electronic engineering, mechanical engineering, aerodynamics, industrial engineering, computer science and engineering, materials science and engineering, mathematical mechanics, social science, and foreign languages. They are further divided into 27 special fields in engineering, science, art, management and economics, and over 50 teaching and research offices and their associated laboratories. Among them, aircraft design, aerodynamics and machine-building are national focal disciplines. They have a strong faculty, good teaching tools and sophisticated experimental apparatus.

Research activities at NAI are carried out by insisting on the policy of "integrated teaching, socially oriented, as a contribution to economic growth and defense build-up." With the cooperation of all the teachers, graduate students and senior undergraduate students, over 800 technical professionals established a branch of the Research Institute of Science and Technology of the Ministry of Aeronautics and Astronautics Industry (MAAI) at NAI. This

branch includes a number of [sub-branch] institutes specifically working on robotic drones, aerodynamics, automatic control, vibration engineering, helicopter technology, testing and sensors; several dozens of laboratories dedicated to light aircraft, aircraft cockpit and environment control, air intake, combustion and heat transfer, aerospace power supplies, electronic engineering, communications engineering, special machining, group technology, applied electrochemistry, experimental mechanics, applied optics, space power technology, and superconductor applications; and a dozen or so research centers such as stealth and anti-stealth technology, robotics and artificial intelligence, orbital dynamics, human science, fan development, model development and soft sciences. It undertakes several hundred national research projects and delivers a large number of technical accomplishments to the nation. Since 1978, NAI has received a total of 315 awards from the central government, MAAI, and the Province of Jiangsu for its technical achievements, including 11 major awards at the National Science Conference, 6 National Invention Awards, 7 National Technical Progress Awards, 3 awards from the National Invention Exhibition, and 1 gold medal from the International Invention and New Technology Exhibit in Geneva. These accomplishments have been widely applied and resulted in significant social and economic benefits.

As early as the late 1950's, NAI successfully developed its first target drone—"NAI-1." In the past 30 years, it successfully developed a number of unmanned [remotely] piloted vehicles, such as the "1015" high-altitude radar umbrella target, the Model "1015" A and "1015" B unmanned airplanes in the "Changkong-1" series, the "Changkong-1" mid-to-high-altitude target drone, a nuclear-testing sampling aircraft, a low-altitude target drone, a super-low-altitude target drone, and high-mobility target drone. The technical performance of these aircraft is at a world-class level, and these items have fulfilled our needs in national defense. NAI has received numerous awards from the government and from MAAI. Based on the requirements in aeronautical and astronautical development, the Institute is demonstrating the feasibility of a multi-purpose unmanned aircraft and is doing a preliminary study on a supersonic target drone.

NAI is an important base for helicopter design in China. It has the only helicopter special field and has the best facilities for helicopter research and design. As early as 1975 it successfully tested a small two-seater helicopter, the "Yan'an No 2." In addition to conducting basic and applied research on helicopters, NAI is also doing research on small helicopters and rotary craft.

NAI has also made considerable progress in light aircraft. The "Voyager" (AD-100) single-seat ultra-light aircraft, which was under development in the mid-1980's, is at a world-class level and its airworthiness has been certified by the China Civil Aviation Bureau for market release. The Model AD-200 is a two-seater developed upon the Model 100. It was successfully flight-tested in March. The Model Ad-400, a four-seater, is also in the feasibility and research stage.

NAI is one of the experimental centers in aerodynamics. It has a variety of test equipment and the associated test means, such as a large world-class serial dual-experimental-section (5.1 x 4.2 m, 3 x 2.5 m) low-speed recirculation wind tunnel; a 600 x 600 mm wind tunnel which operates in subsonic, transonic and supersonic regions; a two-element low-turbulence wind tunnel; a smoke wind tunnel; and a water tunnel. These are used to conduct aerodynamic experiments on objects such as aircraft and aircraft components, automobiles, bridges, buildings, and antennae.

In addition, NAI has a solid foundation for conducting basic research in vibration engineering, air-intake study, combustion and heat and mass transfer, flight-control technology, novel aerospace power-supply systems, spread-spectrum communications technology, signal analysis and processing, CAD and CAM technology, titanium-alloy fabrication, machining of hard-to-machine materials, electromachining technology, microcomputer applications, sensor technology and experimental mechanics, computational mathematics, stealth technology, artificial intelligence, and robotics. It has produced numerous high-level results. Many of them are at the domestic forefront and some are at a world-class level. These achievements form the superiories and distinguishing features of the institute. For example, its eddy-current activator, reusable bow-shaped strain gage, purifier for copper containing waste water, and fluorescent fiber received national fourth-place invention awards in 1985. The 500W and 100W wind-generator system was given a second-place national technical progress award. Its micro-sensor received a gold medal at the 14th International Invention and Technology Exhibit in Geneva in 1986. A fast and accurate method for determining the thermocouple between tool and part received a fourth-place national invention award in 1987. The breeze speedometer based on a single probe rotation testing method and the fiber-optic rotation-angle and torque sensor won bronze medals in the National invention exhibit in 1986 and 1987, respectively. The study on a diagnostic and monitoring method for vibration-induced structural failure and the study on swirl in an S-shaped air intake received second-place technical progress awards from the State Education Commission. A program to process mechanical vibration signals, the Model JZQ-7 permanent magnetic activator, and the Model GF-200 ultra-low-frequency power amplifier won third-place national technical progress awards in 1988. In the meantime, NAI is taking advantage of its knowledge and talents to strengthen its lateral connections. In the past 3 years, the institute has undertaken over 500 projects involving either research or technological transfer. It is engaged in a wide range of technical collaboration with nearly 100 businesses in 15 counties including Nanjing, Nantong, Huiyin, Zhenjiang, Yancheng, and Xuzhou and has established a number of joint ventures which combine teaching, research and production to benefit the society.

In the past decade, NAI has been actively involved in technical cooperation and exchange with the rest of the world. For instance, it is working jointly with NASA in the United States, DFVLR in the FRG, and FAA in Sweden on basic theory and technology. In addition, it is working on helicopter technology with Westland Helicopters [Ltd] in the U.K. and has made good progress. In conjunction with Hewlett Packard, it established the "NAI-CHP vibration-engineering consulting and training center" to provide technical consultation and training and related technical development for the vibration-testing equipment and mode analyzer sold by HP in China.

In order to strengthen exchanges with other countries, NAI is continuously sponsoring international academic conferences. For instance, a joint meeting with the American Helicopter Society, the "International Symposium on Basic Helicopter Technology Theory," was held in Nanjing in 1985. The "Third International Meeting on Metal Cutting, Special Machining and Mechanical Processing Automation" was held in 1987 with Hong Kong Institute of Technology. It will host the "International Exchange Meeting on Vibration Engineering" with the Chinese Vibration Engineering Society in 1990.

NAI has over 50 laboratories and testing centers. Its wind tunnel laboratory, vibration laboratory, electromachining laboratory, materials mechanics laboratory, simulation laboratory, CAD center, and testing center have the most advanced instruments and technical capability.

NAI has a machine shop, an aircraft manufacturing plant, an electronic instrument plant, and an automation equipment plant for teaching and research-oriented production use. It also has several technical development organizations and owns more than 400 pieces of machinery.

Under the new technical development trend and current historic conditions, NAI is working hard to utilize its academic, intellectual and equipment advantages to further strengthen its research and development activities, primarily in applied research. By emphasizing basic research, it is actively organizing high-technology-related research which will take NAI into a new era. NAI must continue its reforms to further develop lateral connections with the outside world. Ideas such as competitiveness, urgency and adaptability must be further emphasized. The operating mechanism must be further perfected and a faster pace must be assumed to make more contributions to socialist economic development and to the defense of national security.

Photo 1. Main Teaching Building at NAI

Photo 2. Tuning and Adjusting Prior to Running the 0.6 x 0.6 m Subsonic-Transonic-Supersonic Wind Tunnel

Photo 3. The First Tri-Axial Hydraulic Flight Simulator Developed by NAI

**Monoclonal Antibodies Specific for K88ab, K88ac, K88ad Antigens of *Escherichia Coli***

40091004a Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 29 No 5, Oct 89 pp 348-353

[English abstract of article by Li Yi [2621 3015] and Liu Xiufan [0491 4423 2753] of the Department of Veterinary Science, Jiangsu Agricultural College, Yangzhou]

[Text] A panel of 12 hybridoma cell lines, secreting specific antibodies to the K88 adhesin antigens of enterotoxigenic *Escherichia coli* (ETEC), was established from eight separate fusions between the mouse myeloma cell line Sp 2/0-Ag-14 and spleen cells from mice immunized with purified K88 antigens. Among the 12 monoclonal antibodies (MCA), K-A, K-35, K-11 and K-15 were K88a specific and reacted with all K88 adhesin-bearing *Escherichia coli* strains tested, whether K88ab, K88ac or K88ad, as demonstrated either by enzyme-linked immunosorbent assay (ELISA) or a direct agglutination test, whereas K32, K-4 and K-3 were specific for K88ab, K88ac and K88ad, respectively.

The antigen patterns of 33 K88-bearing *Escherichia coli* strains covering the three serotypes K88ab, K88ac and K88ad were analyzed by means of these MCAs. The preliminary results show that all *Escherichia* strains with the same K88 antigen serotype shared at least one common antigenic determinant that did not exist on the K88ab strains, and that there were a few K88 antigenic determinants that appeared only on limited *Escherichia coli* strains of the same K88 serotype.

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**Structure Identification of Antibiotic 861-A Used for Wheat Scab Control**

40091004b Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 29 No 5, Oct 89 pp 364-370

[English abstract of article by Bian Zeliang [0593 0463 2856], Zhang Wenxin [1728 2429 0207], et al., of the Institute of Chemistry, Chinese Academy of Sciences, Beijing; Jin Tongming [6855 0681 6900] and Li Xian-gling [2621 7449 3781] of the Institute of Atomic Energy, Chinese Academy of Agricultural Sciences, Beijing]

[Text] The Chinese-made antibiotic 861-A is a major component of the 861 antibiotic complex produced by *Streptomyces roseoalutaceus* var. *pallidus*, which exhibits a broad antibacterial spectrum and prevents wheat scab—one of the major wheat diseases in China.

The chemical structures of 861-A and its hydrolysates have been identified with FAB-MS and GC/MS, as well as through comparisons of the spectroscopic characteristics by IR, <sup>1</sup>H NMR, FAB-MS and TLC of 861-A with those of the reference compound Streptostrericin F. It has been demonstrated that antibiotic 861-A and Streptostrericin F are identical. Additional data is offered regarding the structure of Streptostrericin F.

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**Comparative Studies on Cross Protection Among Cucumber Mosaic Virus Strains, Its Satellite Protection Effects**

40091004a Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 29 No 5, Oct 89 pp 371-377

[English abstract of article by Wu Gusui [3019 6253 4482], et al., of the Institute of Microbiology, Chinese Academy of Sciences, Beijing]

[Text] Tobacco and pepper plants were preinoculated by attenuated cucumber mosaic virus [CMV] with or without satellite RNA, and were then challenged by a virulent CMV devoid of satellite RNA. There were two sets of protection experiments: (1) After preinoculation, the plants were challenged at different times, and (2) after preinoculation, the plants were challenged at the same time. After challenge, the protection effects were detected by symptom survey, protein A sandwich ELISA of the virulent CMV strain, and dot-blot hybridization of the satellite RNA. The investigation of symptom expression, virus accumulation and disease index change demonstrated that the conventional cross protection, although present, was visible 10 to 15 days following preinoculation, but generally was not very strong. Satellite protection effects were more effective, particularly 15 days following preinoculation. The results revealed that the protection effects of CMV containing satellite RNA differed from the conventional cross protection, with the later superposed or supplanted by the former in the plant.

Satellite RNA was eliminated by two gelulations followed by single lesion selection in *C. quinoa*. No satellite appeared during the 2 month protection experiments, but when the isolates were propagated in tobacco, substantial quantities appeared following four passages. These results constitute an invitation to explore the possible origin of satellite RNA from the host genetic apparatus, or from *de novo* generation.

This project was supported by the Science Foundation of the Chinese Academy of Sciences.

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**Studies of Enhancement of Nonspecific Resistance to Infection by Leptospiral Lipopolysaccharide. II. Mechanisms of Nonspecific Protective Activity of LPS**

40091004d Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 29 No 5, Oct 89 pp 383-389

[English abstract of article by Zhou Wenjing [0719 2429 7234], Nie Dikai [5119 4574 2818] and Wu Suhuai [2976 4790 2037] of the Institute of Epidemiology and Microbiology, Beijing]

[Text] Leptospiral lipopolysaccharide can enhance the nonspecific resistance of a host to infection. By researching its mechanism, the authors found: (1) The phagocytic function of peritoneal macrophages of guinea pigs was strengthened by E-LPS and L-LPS; (2) L-LPS and E-LPS activated the peritoneal macrophages of mice then enlarging the cell, and increased the quantity and activity of intracellular acid phosphatase. In relative terms, the L-LPS may have a greater influence on the synthesis of the enzyme, while the E-LPS mainly enhances the activity of the enzyme; (3) L-LPS and E-LPS both appeared to be immunomodulant. When

they were injected 3 days after the mice had been immunized with SRBC, the immune adjuvant effect developed; however, if the injection of LPS was given 24 hours prior to the immunization, immunosuppression resulted.

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#### Studies of Endotoxin of *Leptospira*. V. Effect of EDTA-Na on Release of LPS of *Leptospira* Interrogans Serovar Lai

40091004e Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 29 No 5, Oct 89 pp 390-393

[English abstract of article by Wu Suhuai [2976 4790 2037], Jiang Shuxian [1203 3219 6343], et al., of the Institute of Epidemiology and Microbiology, Beijing]

[Text] The yield of leptospiral LPS was increased one to two times when the cells were treated with EDTA-Na before extracting with the hot phenol-water method. The colors and solubility of L-LPS were improved. When the leptospiral cells were stored for a long period of time and treated by EDTA-Na, the phase distribution of the LPS changed, i.e., they returned from the water phase into the phenol phase. Such a change was related to the quantity of both the saccharide and the lipid.

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#### Intraperitoneal Injection of *Heliothis Armigera* Nuclear Polyhedrosis Virus into Test Animals

40091004f Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 29 No 5, Oct 89 pp 394-396

[English abstract of article by Peng Fenggang [1756 7685 0474] of the Institute of Plant and Environmental Protection, Beijing Municipal Academy of Agricultural and Forestry Sciences, Beijing]

[Text] The *Heliothis armigera* nuclear polyhedrosis virus purified by sucrose gradient centrifugation was injected into the peritonea of nude mice, golden hamsters and mice. On day 13, 23, 30 and 40 postinjection, the animals were killed and internal organs (liver, kidney, spleen, pancreas) were extracted. The second or third instar *Heliothis armigera* larvae fed with homogenized internal organs showed the nuclear polyhedrosis and mortality was 30 percent. Under electron microscopy inclusion, bodies could be found in the cytoplasm of the liver and spleen cells of nude mice on days 13 and 23 postinjection. The paper indicates that certain insectile

viruses can infect and reproduce in vertebrates and still preserve their biological activity.

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Cloning, Sequence Analysis of Salmon Prolactin cDNA

40091004g Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese Vol 16 No 5, Oct 89 pp 374-380

[English abstract of article by Song Shiduo [1345 6108 6995] of the Department of Medicine, Second Teaching Hospital, Tianjin Medical College; K.Y. Trinh and C.L. Hew of the Department of Clinical Biochemistry and Biochemistry, Toronto University]

[Text] A cDNA library was prepared from Pacific Chinook Salmon pituitaries. The salmon prolactin gene was screened using synthetic oligonucleotide probes based on a partial protein sequence. A positive clone (PRL-10) was identified and sequenced. It is a full-size clone containing 1.1 kb and coding for a preprolactin of 211 amino acids.

This project was supported by the Medical Research Council of Canada, the National Science and Engineering Research Council of Canada and the Hospital of the Sick Children Foundation.

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Nucleotide Sequence of Chloroplast *psbA* Gene from *Solanum Nigrum* Atrazine Resistant Biotype, Its Relevant Analysis

40091004h Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese Vol 16 No 5, Oct 89 pp 381-388

[English abstract of article by Zhu Lihuang [2612 4539 3552], Hu Naibi [5170 0035 3880], et al., of the Institute of Genetics, Chinese Academy of Sciences, Beijing]

[Text] The *psbA* gene cloned in pSB135 from the *Solanum nigrum* atrazine-resistant biotype was sequenced. It has the same nucleotide sequence as the known atrazine resistance gene from another independent biotype of *S. nigrum*. On the basis of the deduced amino acid sequences, the secondary structures of the 32kD proteins encoded by the *psbA* genes are compared for the atrazine-resistant and susceptible biotypes, and some indications from the protein structure comparison are discussed.

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**New Cloning Vectors Constructed in *Bacillus***  
*40091004i Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese Vol 16 No 5, Oct 89 pp 389-398*

[English abstract of article by Qiao Mingqiang [0829 2494 1730], Cai Baoli [5591 1405 4539], et al., of the

Institute of Molecular Biology, Nankai University, Tianjin; Jiang Ruzhang [5592 1172 3864] of the Department of Biology, Nankai University, Tianjin]

[Text] Two new plasmids, pNQ216 (4.1kp) and pNQ402 (2.8kb), were constructed by combining the replication origin of the plasmid pNK289, a cryptic plasmid residing in *B. pumilus* 289, and the *cat*-86 gene from plasmid pPL601. These two plasmids can be maintained steadily in both *B. subtilis* and *B. pumilus*. The penetrance of these plasmids on an LB medium with Cm (20 µg/ml) is 30 percent higher than that of pPL600. Therefore, both plasmids can be used as new cloning vectors in *Bacillus*.

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**Expression of Human Interferon Gene Controlled by SV40 Late Promoter in Mouse Myeloma SP2/0 Cells**

40091004j Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese Vol 16 No 5, Oct 89  
pp 399-403

[English abstract of article by Wang Xiaoming [3769 2556 7686], et al., of the Institute of Microbiology and Epidemiology, Academy of Military Medical Science, Beijing; Wu Shuhua [0702 3219 5478], et al., of the Institute of Virology, Academy of Chinese Preventive Medicine, Beijing]

[Text] The *Hind*II fragment of human interferon  $\beta$  (IFN- $\beta$ ) gene was inserted downstream from the SV40 late promoter in pSV2-dhfr and cotransferred with pSV2-gpt into the mouse myeloma SP2/0 cells which were hypoxanthine guanine phosphoribosyl transferase (HGPRT) deficient. After selection in a HAT (hypoxanthine aminopterine thymidine) medium containing myciphenoic acid and xanthine, the efficient constitutive expression of IFN- $\beta$  could be detected in the supernatant of the surviving cells.

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**Cloning of PHO11 Gene, Its Location on Chromosome**

40091004k Shanghai SHENGWUHUA YU SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 21 No 5, Sep 89 pp 408-413

[English abstract of article by Chen Jiangye [7115 3068 6851], Gong Yi [7895 3015], et al., of the Shanghai Institute of Biochemistry, Chinese Academy of Sciences; Zhu Yiwen [2612 1837 2429] and Kuang Daren [0562 6671 0086] of Shanghai Institute of Cell Biology, Chinese Academy of Sciences]

[Text] PHO11 belongs to the acid phosphatase gene family in yeast and its expression is repressible by inorganic phosphate. The authors have isolated a 5kb EcoRI fragment containing the complete PHO11 gene from a yeast gene library. The fragment was analyzed with restriction mapping, Southern hybridization and DNA sequencing. The homology between PHO11 and another repressible acid phosphatase structural gene, PHO5, was compared. Using pulsed field gradient gel electrophoresis, the PHO11 gene was located on yeast chromosome VIII.

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### **Upstream Activating Sequences of Yeast Acid Phosphatase Gene PHO11**

40091004l Shanghai SHENGWUHUA YU  
*SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese* Vol 21 No 5, Sep 89 pp 414-420

[English abstract of article by Gong Yi [7895 3015], Chen Jiangye [7115 3068 6851], et al., of the Shanghai Institute of Biochemistry, Chinese Academy of Sciences]

[Text] The yeast acid phosphatase gene PHO11 is a repressive gene. The expression of the gene is in response to the presence or absence of exogenous inorganic phosphate. To study its regulatory mechanism, the coding region of PHO11 was fused with the LacZ gene, and the gene expressional level was assayed by measuring the beta galactosidase activity. Using restriction endonuclease and nuclease Ba131, the 5'-flanking sequences of PHO11 were deleted. The expressional level of various deletion derivatives showed there were two upstream activating sequences (UASs) located at -403 to -464 and -271 to -323 upstream of the initiation codon.

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### **Primary Structure of Acid Phosphatase Gene PHO11 in *S. Cerevisiae*, Comparison with Other Gene Families**

40091004m Shanghai SHENGWUHUA YU  
*SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese* Vol 21 No 5, Sep 89 pp 437-444

[English abstract of article by Chen Jiangye [7115 3068 6851], Gong Yi [7895 3015], et al., of the Shanghai Institute of Biochemistry, Chinese Academy of Sciences]

[Text] The authors have sequenced the PHO11 gene for yeast repressible acid phosphatase. The PHO11 gene codes 467 amino acids as deduced from 1,404 nucleotides. It exhibits a CBI of 0.54. The coding region, 5'-noncoding region and 3'-end region have 57 percent, 65 percent and 69 percent AT contents, respectively. Two other terminal codons, TGA and TAA, were found in the downstream region of the first terminal codon TAA. The coding regions of the PHO11 and PHO5 genes exhibit homology both at the nucleotide (74 percent) and the amino acid (85 percent) levels. There are 10 possible glycosylation sites in the deduced amino acid sequence.

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#### Purification, Characterization of Radioprotective Polysaccharide from *Spirulina Platensis*

40091004n Shanghai SHENGWUHUA YU  
SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 21 No 5, Sep 89 pp 445-449

[English abstract of article by Pang Qishen [1690 0796 3234], Guo Baojiang [6753 1405 3068], et al., of Zhongkai Agricultural and Technical College, Guangzhou]

[Text] SP-1, a radioprotective polysaccharide of *Spirulina platensis*, was prepared by ethanol precipitation of

a hot water extract and further purified by DEAE-cellulose and Sephadex G-200 column eluted with water. Its homogeneity was examined by polyacrylamide gel electrophoresis, high pressure liquid chromatography (HPLC) and Sephadex G-200 chromatography. The estimated molecular weight of SP-1 is 12590. Both IR and <sup>1</sup>H NMR spectroscopy showed that SP-1 had an α-glycoside linkage. It is composed of D-mannose, D-glucose, D-galactose and glucuronic acid in the proportions of 30.9 percent, 29.8 percent, 22.7 percent and 16.5 percent, respectively.

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#### Influence of DNA Conformation, Base Composition Flanking Recognition Sites on Cleavage Rate of Restriction

40091004o Shanghai SHENGWUHUA YU  
SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 21 No 5, Sep 89 pp 456-460

[English abstract of article by Sun Liankui [1327 6647 7608] and Ruan Hong [7986 1347] of the Department of Biology, Northeast University, Xi'an]

[Text] The relationships between the nucleotide sequences adjacent to the recognition sites and the

cleavage rate of DNA with restriction endonucleases were investigated. Our data indicate that the recognition sites flanked by the A-T rich sequences are cleaved faster than those flanked by G-C-rich sequences, regardless of the DNA conformation.

This project was supported by the Science Foundation, Chinese Academy of Sciences.

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#### Expression of HBcAg Gene with Different 5'-Terminal Sequences in *E. Coli*

40091004p Shanghai SHENGWUHUA YU  
SHENGWUWULI XUEBAO [ACTA BIOCHIMICA ET BIOPHYSICA SINICA] in Chinese Vol 21 No 5, Sep 89 pp 470-476

[English abstract of article by Gong Yi [7895 3015] and Ao Shizhou [2407 0013 3166] of the Shanghai Institute of Biochemistry, Chinese Academy of Sciences]

[Text] The 5'-terminal of the HBcAg gene was deleted by the nuclease Ba131, and several HBcAg genes with different 5'-terminal sequences were obtained. These HBcAg gene fragments were inserted to the downstream position of the Tac promoter. The gene expression level was determined by measuring the HBcAg activity of the cellular extract. The relationship between the 5'-terminal sequences of the HBcAg genes and the gene expression level is discussed.

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#### Ion Beam Biology—An Emerging Science in China

40081006a Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 17 Nov 89 p 4

[Summary] Researchers from the Institute of Plasma Physics, Chinese Academy of Sciences, and the Rice Research Institute, Anhui Academy of Agricultural Sciences, have successfully produced new crop varieties through ion beam induction techniques. Three new rice strains—J804, J809 and J876—have been obtained from the 02428 mother strain. The new varieties are said to be highly productive and highly resistant. By modifying the equipment of ion and electricity generators and reconfiguring the target and sampling chambers, ion beam injection techniques can be converted from treating non-living matter to conducting mutations of living organisms—a new application for ion beams in biological research. The advantage of using ion beams as inducers lies in their physical and chemical properties in mutagenesis. The ion beams' capability to select mutation sites, which differs from traditional mutagens, opens up new possibilities for their wider applications in mutagenesis breeding studies.

**Artificial Skin Developed**

40081006b East Berlin TECHNISCHE  
GEMEINSCHAFT in German No 10, Oct 89 p 13

[Summary] A Chinese scientist from Shandong Province has successfully treated burns using a type of artificial skin made of the skin of shrimp and prawns. Tests involving 200 burn cases of varying severity demonstrated good healing. Experts claim that the new skin is biologically active and "breathes."

**Beijing Hospital Develops New Skin Grafting Method**

40101005a Beijing XINHUA in English 20 Nov 89

[Text] A new skin grafting method, combining the patient's and donor's skin, was developed recently at Beijing's Jishuitan Hospital.

In the past, the death rate for victims suffering third-degree burns was high since their own skin could not cover the area in time, and it was difficult to treat such injuries with surgical methods in time as well. Clinical application on more than 40 patients has demonstrated a 70 percent success rate. The new method also leaves very little scarring.

**Scientists Produce Third-Generation Growth Hormone**

40101005b Beijing XINHUA in English 4 Dec 89

[Text] Chinese scientists have successfully produced a third-generation human growth hormone with genetic

engineering techniques. Tests showed that the products are exactly the same as natural growth hormones in both structure and functions.

Human growth hormone is a protein that has notable effects in promoting growth.

The scientists also used their hormonal products in testing mammals. The results demonstrate that the third-generation growth hormone promotes the growth of animals as well.

**First Virus-Resistant Tomato Plant Developed**

40101005c Beijing XINHUA in English 5 Dec 89

[Text] Using bio-engineering techniques, Chinese scientists have developed a new kind of tomato plant which is resistant to the cucumber mosaic virus, a widespread vegetable disease affecting more than 700 species of plants.

Tian Bo and his colleagues at the Institute of Microbiology, Chinese Academy of Sciences, successfully synthesized the gene of the cucumber mosaic virus and introduced it into the chromosome of the cell nucleus of a tomato plant. They thus produced new tomato plants that are genetically resistant to the cucumber virus.

The new strain is expected to put an end to the summer phenomenon of a large amount of tomato withering.

**New 32-Bit Acceleration Board, Personal Workstation From Gold Valley Electronics Co., Ltd.**

**Introduction**

*40080238 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 31, 9 Aug 89 p 1*

[Article by Liu Jiuru [0491 0046 1172]: "New Model Chinese-Manufactured Accelerator Board Is Announced"]

[Text] The Jingu [Gold Valley] Electronics Company, Ltd., jointly funded and run by Institute No 23 of the Ministry of Aeronautics and Astronautics Industry and the Hong Kong Hengyu [1854 5940] Science and Technology Company, Ltd., recently successfully developed a new model Chinese-manufactured microcomputer accelerator board—the GV-780 Accelerator Board.

This device is a complete 32-bit single-board computer that has a very high degree of integration, and when inserted into an expansion slot of an ordinary microcomputer, the capacity of that computer increases by 16 times, and speed can be improved 200 times and more, reaching 1.3 MIPS [million instructions per second]. As a consequence, ordinary microcomputers can function as minicomputers or as mid-sized computers, as far as calculations are concerned, which provides a direction for the upgrade and replacement of microcomputer applications.

In addition, the Jingu Electronics Company has also introduced the GV-PW1 Graphics Workstation based on a close integration of the GV-780 Accelerator Board. It is composed of the GV-780 and the GV-GR/32 high-speed, high-resolution graphics card, which enables the microcomputer to have the calculation capability and graphics processing capability of engineering workstations.

**Details on the Accelerator Board**

*40080238 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 30, 2 Aug 89 p 14*

[Unattributed article: "the GV-780—A Fully 32-Bit Accelerator Board Giving PCs the Speed of Minicomputers and Mid-Sized Mainframes"]

[Text] The GV-780 Accelerator Board is a fully 32-bit accelerator card developed by the Jingu Development Company that plugs into IBM PC XT/AT (or compatible) and 386 microcomputers. It uses the MC68020 as its CPU, the 68881 as its high-speed floating-point coprocessor (FPU), can accept the 68851 as its paged memory management unit (PMMU), and it can accept 1, 2, 4, 8, or 16 megabytes of RAM on-board. Its clock speed is 20 MHz, and it also has two RS-232-C serial ports. The board has complete management circuitry, including bus control, bus arbitration, DMA [direct memory access] control, and on-board memory management, as well as refresh and interrupt control.

The GV-780 operates under PC-DOS, MS-DOS, or MOS386 operating systems and comes with a 68020

assembler, and FORTRAN, C, and Pascal high-level-language compilers. These compilers have been modified from Unix system compilers and use a high degree of global optimization, are highly compatible with standard versions of FORTRAN, Pascal, and C languages. There is internal compatibility among the 3 compilers, which may call each other.

By inserting the GV-780 accelerator board into a PC XT/AT and executing the corresponding interface routine, this card will act as a relatively independent, full 32-bit computer system, at which time the PC XT/AT only performs peripheral management for the accelerator. It performs only such peripheral and I/O control as a controlling network for floppy and hard disks, display input, and printer output. All data processing and scientific calculations are accomplished independently by the accelerator card. Therefore, the operational speed of the entire system is greatly improved. Testing with the standard Whetstone benchmarks, the GV-780-4M achieves 1.3 million Whetstones, while the VAX 780 does 1 million and the high-performance VAX 8600 does 2 million.

The benefits of the GV-780 lie in:

1. By means of an expansion card, it brings the calculating capability of mini- and mid-sized computers to MS-DOS systems, allowing users of microcomputer systems to easily obtain the speed of those larger computer systems;
2. Its full 32-bit bus structure ensures quick operation and high-speed addressing for the GV-780, while also keeping the precision of calculations equal to that of the IBM 4341;
3. Its 1- to 16-megabyte linear address space is a significant breakthrough over the 640K memory limits of DOS systems, nor is there any limit to array sizes, which allows a user to easily and conveniently implement on microcomputers the scientific calculations and finite-element analysis routines that in the past could only be run on mainframes;
4. Its price is quite reasonable, being only one-tenth that of mini- or mid-sized computers;
5. And it is extremely easy to use. One needs no training nor any particular hardware configuration of any kind; use of this board will have no effect upon original PC software or hardware resources.

**Details on Graphics Workstation**

*40080238 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 30, 2 Aug 89 p 14*

[Unattributed article: "The GV-PW1 Graphics Workstation"]

[Text] Based upon the development of the GV-780 accelerator board, the Jingu Electronics Company has also developed the GV-PW1 (Personal Workstation) Graphics Workstation, which brings a high-speed, fully 32-bit graphics workstation to the IBM PC XT/AT.

The GV-PW1 graphics workstation is built from two full-length PC bus plug-in cards. One is the GV-780 accelerator card, and the other is the VG-Graphics 32 graphics card. The two cards are closely coupled by means of a 132-line connector. Through this connector, the slow AT bus is by-passed, to be replaced with a high-speed 32-bit bus, allowing direct exchange of data with the GV-780 accelerator board, and enabling the data exchange rate to be improved some 10 times. The GV-Graphics 32 graphics board uses the Intel third-generation graphics processor chip, the 82786, which has powerful graphics and text-processing capabilities, and which can directly handle more than 30 graphics commands. It has unique hardware interface functions, provides hardware support for translation and scrolling, and supports multiple windows and multi-tasking. The board holds 1 megabyte of high-speed static-column RAM, which greatly improves the display refresh rate of the graphics processor. Graphics resolution can go from 640X350, to 800X600, to 1024X768, and 256 colors may be displayed from a palette of 16 million. It has both TTL [transistor-transistor logic] video output and analog video output, and therefore may be used with TTL and analog-input CRTs, as well as with Multisync and Multiscan CRTs.

In addition to the software provided with the GV-780 board, the GV-PW1 Graphics Workstation also comes with a C-language graphics library that has a complete set of functions, allowing the user to quite conveniently develop his own application programs, and it also comes with the currently quite popular AutoCAD software.

Development of the GV-PW1 Graphics workstation is intended to meet the demand of GV-780 users for speed and resolution in their graphics environment. Users working under the XT or AT graphics environments can with minimum outlay upgrade their system to a personal workstation that has high speed and high resolution. Under normal conditions, this speed and resolution would cost twice as much.

The most remarkable feature of the PW1 Graphics Workstation is its speed. One factor for this is the speed of the GV-780 accelerator card itself, which is 200 times faster than a normal XT. The 82786 chip already has in itself most driver capacity and control functions needed in a graphics card. What functions remain are specific to the needs of a particular environment. It is furnished with such appropriate circuitry as address decoding, has control data selection, and interface data format conversion (because the Motorola and Intel series data formats are defined differently), which can both constitute an entire system and also greatly reduce the cost of circuit design, so the system reliability is correspondingly improved. The GV-PW1 Personal Workstation can drive various printers and plotters, can accept a mouse, and can run on networks.

### Apollo Workstation Gets Chinese Characters

90CF0038A Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 33, 30 Aug 89 p 1

[Article by Xiao Yan [2556 3601]: "Chinese-Character System for the Apollo Workstation"]

[Text] The CCDOMAIN System is an Apollo-workstation-oriented Chinese-character system that was developed by the Computer Department of Beijing Science & Technology University. On 9 August, the system passed an appraisal by the Office of Design Management of the Ministry of Construction. The appraisal committee unanimously declared the "Apollo Workstation Chinese-Character System, CCDOMAIN," to be an example of the most successful domestic attempts to date of bringing Chinese character handling to the system level of the Apollo 32-bit workstations.

CCDOMAIN is a system-level (kernel) Chinese-character system run under the support of either AEGIS or UNIX operating systems. After it brought Chinese characters to the original display management system DM, it added Chinese character-handling functions, still retaining the original DM functions and completely identical operating methods. The Chinese-character CCDOMAIN can run under the higher versions of the AEGIS SR9.5/9.6/9.7/7.1 operating system and the corresponding Unix System 5/BSD 4.2 version, and it is suitable for the DNSX0, and the DN3000 [models] currently offered by the Apollo Company, as well as all workstation series offered in future.

This Chinese-character system has the following characteristics:

1. It is entirely managed by the operating system, and is automatically booted after power-on, no other operation need be appended, and the Chinese character display is fast (nearly the same as for Western-language text);
2. Operation is simple and is completely compatible with the existing system;
3. Chinese-character editing is complete in full-screen or multiple-window modes, it retains all original EDIT functions, it can support various single-character or phrase Chinese-character input methods (12 at present), and it can be expanded at any time;
4. It allows phrase input, associative input, self-learning input, common-character input, all corner ASCII coded input, and various writing directions, as for example right-to-left and top-down;
5. One can directly use Chinese characters as strings in high-level-language source code, and they can also be used as variables in the Common LISP language;
6. It has various dot-matrix character libraries of abundant, attractive typefaces, and new character libraries may be added conveniently at any time;

7. Chinese characters may be conveniently used in graphics, and the bitmapped graphics package GPR provided with the Apollo workstation and the graphics package GMR, which is based on the source file (matefile), can use both raster Chinese characters and vectored Chinese characters, and such attributes may be set in them as color, typeface, length proportioning factor of the vectored Chinese characters, and limitless degree of rotation;

8. And Chinese characters may be used identically with Western text to fill in the ICON region in the application program Dialog, to be the prompt.

Since the successful development of CCDOMAIN, the system has drawn the attention and praise of users and professionals both at home and abroad.

### **Domestic Computer Industry Grows Steadily First Half of Year**

*90CF0039B Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 34, 6 Sep 89 p 1*

[Article by Tang Baoxing [3282 1405 5281]: "China's Computer Industry Grew Steadily During First Half of Year"]

[Text] This reporter learned recently at a meeting of some factory directors and managers from throughout the country as convened by the Computer Office of the Ministry of Machine-Building and Electronics Industry (MMEI) that during the first half of this year, there was moderate growth in China's computer industry, where output value rose 18 percent over that of the same period last year, and slightly more than one-third that planned for the entire year. Among products, 30,000 learning machines were manufactured, 21,900 microcomputers, 149 mini- to mid-sized computers, and 125,400 peripherals of various types. Among the largest seven computer enterprises in China, the production of six was better than that for the same period last year.

By analysis, during the first half of this year, factors for the steady growth of the computer industry include: plans for reduced spending by the state were not yet in place, and sales of computers were still on the rise; each enterprise adjusted its product structures, adding effective provision, developing name brands, producing products with high added values, and increasing exports; and support by the state of the computer industry, amounting to an annual provision of 200 million yuan in interest loans for computer applications, as well as provision of four preferential policies for computer production firms, and protection of civilian industries, all these factors being beneficial to the growth of production. At the same time, there was also much attention paid by all provinces and municipalities toward the computer industry, and there was the diligence of the enterprises' staffs, which ensured a rise in production.

But full-scale attainment of this year's production plans would require a great deal of effort, and when one considers the fact that the disruption of the current domestic computer market has yet to be thoroughly

rectified, this lends a degree of difficulty to accomplishing the production planning. To this end, the computer companies have pointed out that each enterprise must actively expand its market, enhance its quality control, improve after-sales service, and especially improve the rate at which systems work out of the box; they must make good use of state-provided preferential policies, deduct sufficient research and development funds, develop new products, and manufacture such marketable goods as 286 micros, the common PC, portables, and the 386 computers. As far as adjusting markets is concerned, the Computer Office requests that each enterprise "begin with itself" in strictly forbidding resale of imported components, and to exert great effort in overcoming the confused state of the current market.

At present, nearly every enterprise is faced with many difficulties, but the computer market still looks promising. Reliable sources believe that China's computer industry over this year and next will maintain a moderate growth rate of better than 10 percent.

### **New PAO, EPROM, and GAL Programmer Developed**

*90CF0038C Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 34, 6 Sep 89 p 20*

[Article by Wang Lei [3769 7191]: "The Model CL-P4 General-Purpose Programmer Makes It Debut"]

[Text] In May of this year, Assistant Professor Wang Bangzhu [3769 6721 2691] of Beijing Aerospace University first developed the CL-P3 3-way programmer for use with PAL [programmable array logic], EPROM, and single-chip computers. He then extended this device into the CL-P4 general-purpose programmer for programming 4 kinds of chips: GAL [generic array logic or gate-array logic], PAL, EPROM, and single-chip computers, and which can be used to program more than 55 kinds of chips.

Besides its wide range of use, this programmer is also extremely reliable, flexible, and practical as far as design of functions is concerned. For example, to avoid mistaken operations, the programmer does not provide the user with a manual-configuration selection switch, but the user may select the programming mode and programming parameters for EPROM [erasable programmable read-only memory] chips, which makes it suitable for the programming demands of the new types of EPROMs. As another example, it can automatically record and display the number of times a GAL chip has been programmed, which is very significant for development work and quality control.

This programmer is built on a small platform, is connected by an RS-232C general-purpose port to the host computer, which construction is more convenient than the general programmer card and is more adaptable. Interfacing software has been developed that runs on the IBM PC XT/AT and 286/386 models, as well as their compatibles.

Also with this programming outfit comes the first GAL/PAL general-purpose gate-array compiler software offered domestically with its own copyright. When compared with certain similar foreign software (such as FM.EXE), it is seen to have a stricter syntax and can more easily uncover problems in logic descriptor files (when FM.EXE is used with PALS, certain errors are not detected), and avoid generating erroneous fuse-point maps. This is particularly important for technicians having their first exposure to gate arrays. To enhance the degree of user friendliness, the designer combined all tools software needed for programming into an integrated program; functions are called by menu, and key configurations are shown in graphics, which makes its use easy to grasp.

The CL-P4 general-purpose programmer has been selected for the 1989 international exposition in Beijing. The Shenzhen Jingke [0079 4430] S&T Development Company has partially funded the development of this programmer, and it is currently working with the designer to manufacture and market the device, which will quickly satisfy the needs of China's many scientists and technicians.

**Computer Software Can Think for Itself**  
40100019 Beijing CHINA DAILY in English 5 Dec 89 p 3

[Article by Wang Dongtai]

[Text] A new computer software that is said to be able to study problems independently of humans, was approved by the Technology Bureau of Chinese Academy of Sciences on Friday.

The software called "NeuNet Version 1.0," is the result of research in the field of "intelligent computers," under the High Technology Programme organized by the State.

According to Dai Ruwei, a computer expert from the Automation Institute of the Chinese Academy of Sciences, the artificial neural network in the software has the ability to study things on its own. When the computer has learned the experiences of human beings, it will be able to solve certain intellectual problems by itself.

For example, the software has been used to diagnose potential accidents in nuclear reactors.

Yang Yiping, a researcher who designed the diagnosis programme, said the computer can get data from various parts of nuclear reactors. The information goes through a network which is like an artificial brain's nerve network. The result can tell which part of the nuclear reactor is going to have an accident.

In the computer room of the Automation Institute of the academy, Su Xiaowu, another researcher, is trying to get the computer to talk. He writes Chinese words on a board, presses a button, and the computer recognizes the words and pronounces them.

**High-Power Pulsed Laser Device Developed**

40100020 Beijing CEI Database in English 19 Dec 89

[Text] Tianjin (CEI)—A YAG [yttrium aluminum garnet] high-power pulsed laser device, which can be used to process metal and non-metal materials including jadeite, agate, and diamond, has been developed here recently.

Testing shows that the device has an output power of 528 Watts, larger than the 500-W international standard. The pulse of the device repeats 400 times a second, nearly doubling the present world standard.

Together with the device, a high-power pulsed solid-state laser switch and silicon-controlled power source has also been developed. It has a single-way capacity of 15 kW, about three times that of the current international standard of 5-6 kW. This has raised the continuous working time of the laser device under high temperature and high charge to 15 hours, 10 hours more than the world standard.

The device has been developed by Professor Yao Jianquan of Tianjin University and his research group.

**Multi-Layer Thin-Film Thickness Determination System Developed**90CF0132A Shanghai WEN HUI BAO in Chinese  
17 Oct 89 p 2

[Unattributed article: "Multi-Layer Thin-Film Thickness Determination System Certified in Shanghai"]

[Text] A world-class multi-layer thin-film thickness determination system, which is the result of a fundamental theoretical study and which has a wide range of applications in high-technology areas, was successfully certified by experts at the Shanghai Institute of Silicates of the Chinese Academy of Sciences. This project was supported by the National Natural Science Foundation. It was completed by Associate Researcher He Yancai [0149 1693 2088] of the Shanghai Institute of Silicates and Chief Engineer Chen Jianguang [7115 1367 0342] of the Steel Research Institute of Baoshang Steel Works in Shanghai.

This thickness-determination method has a wide range of applications in a variety of high-technology products. For example, it can be used to accurately measure the thickness of every layer in a VLSI (very-large-scale integration) circuit which allows us to improve and control the quality of such high-technology products. The accuracy of measurement is approximately one ten-thousandth of a diameter of a human hair. The microelectronics industry in Japan and the United States is interested in this type of research; however, they can only measure the thickness of a single layer.

Since 1978 Associate Researcher He Yancai of the Shanghai Institute of Silicates has been involved in the study of electron scattering in solids and in Monte Carlo

calculation. In collaboration with Chen Jianguang and others, he has had five world-class achievements and published over 70 papers in academic journals throughout the world.

**Advances in Remote-Sensing Technology in Sichuan Reported**90CF0132B Tianjin ZHONGGUO JISHU SHICHANG BAO [CHINA TECHNOLOGY MARKET NEWS]  
in Chinese 18 Oct 89 p 1

[Article by Gao Zhu [7559 2691]: "Advances in Remote-Sensing Technology in Sichuan"]

[Text] In the past 40 years, Sichuan has made a great deal of progress in remote-sensing technology. More than 40 research organizations in remote sensing have been established, forming a team of over 2,000 technical people. They have progressed from general testing to specialized applications. A comprehensive applied research system has been created, from space to ground, from macroscopic to microscopic observation. This system is becoming a powerful means for surveying resources, analyzing land utilization, protecting the environment, and forecasting and predicting disasters; it is very effective in contributing to the growth of the national economy.

In the area of taking and processing remote-sensing pictures, Sichuan has developed methods to use multiple sensors to obtain pictures and data at various altitudes and times and in various bands, instead of using the aerial maps taken from a single apparatus. Optical information processing and digital processing have been developed to replace chemical processing and optical manipulation of photographs; this not only improves the quality and resolution of the images, but also increases the speed of analysis and rate of accuracy.

Sichuan and other provinces have successfully developed a CCD [charge coupled device] satellite video system consisting of an array of 2048 digit lines. It was successfully used on the first geo-survey satellite launched in 1985 to obtain CCD images higher in resolution than those of the U.S. MSS [multi-spectral scanner] satellite, and comparable in resolution to the CCD images from the most advanced French SPOT satellite. The successful development of instruments such as a frequency-capture receiver for use in a low-orbit satellite tracking and control station, an ultra-short-wave dual-frequency transmitter and a dual-frequency tachometer locator has contributed to the development of China's remote-sensing from space.

A geological survey was conducted over Sichuan by remote-sensing in order to conduct structural geology and seismic geology studies and to look for coal, oil and gas, uranium and nonferrous metals, and to conduct geological surveys for engineering purposes. In addition,

remote-sensing has been used for soil survey, land-utilization survey, prairie-resource survey, forest survey and reserves estimation, and near-term land-utilization-status survey.

Methods for urban pollution monitoring and pollution-source investigation have been studied and urban ecological evaluations and land-pollution and soil-erosion surveys have been conducted by our technical people. They have used color infrared pictures and field spectra to verify the data collected with conventional methods and determined the sources and extent of pollution in the Nanhe basin in Chengdu. Continuously synchronized stereo-cinematography of moving mud-rock flows was developed as a means for productive dynamic monitoring of such events. It is the most advanced method in China and has improved the accuracy in the forecast and prediction of such events. In the area of landslide research, for the first time both aerial and ground remote-sensing methods have been used to study the cause of landslides around Xinhua village in Tongjiezi along the Dadu He. A prevention plan has been proposed. Based on aerial pictures, it was discovered that a village near the Lianghong Station on the Chengdu-Kunming Railroad was located on an ancient landslide site which was in an early stage of revival. After this was confirmed on-site, timely advice was given to the provincial government to provide funding for relocation. In order to avoid a crisis threatening the existence of pandas, our "national treasure," spectral variation of the entire life cycle of arrow bamboo, its main diet, was monitored, providing a scientific basis for the prediction of the blooming and death of such plants.

In studying the ecological impact of large-scale hydropower projects on the environment and associated counter-measures, a combination of remote-sensing and field observation was used to study the effects and counter-measures of the Sanxia project on the ecology and environment in western Hubei, eastern Sichuan and the Sichuan Basin and on human living conditions. This has provided an important basis for scientific decision-making.

#### **Research, Development of Optoelectronics Technology Noted**

90CF0132C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 23 Oct 89 p 3

[Article by Wang Qiming [3769 0796 2494] and Wang Li [3769 5461]: "Research, Development of Optoelectronics Technology Noted"]

[Text] Information technology is a part of everyday life in every field. It is one of the pillars supporting both material and spiritual civilization.

Compared to electronic information technology, optical information technology not only has higher speed and larger capacity but also is resistant to electromagnetic interference. The development of optoelectronic devices and the associated integration technology signifies the

fact that information technology is entering an optoelectronic era from an electronic era. There is sufficient reason to believe that the 21st century belongs to the optoelectronics industry, just as the 20th century belongs to the electronics industry.

The development of optoelectronic devices and the associated integration technology pushes optical communications and optical information processing rapidly forward. In optical communications, there are 4,535,000 kilometers of optical fiber installed in the world (approximately 4,000 kilometers in China). This is 10 times the distance from the earth to the moon. The output value of optical communications was appraised at US\$600 million in 1985 and is estimated to reach \$6.5 billion by 1990 and \$40 billion by 2000. Many countries have announced that they will no longer install [coaxial] cables for communications.

Research in optoelectronic devices began in the early 1960's in China, nearly 30 years ago. However, because we only focussed on research and neglected development, only a few prototypes were fabricated. There were no products to meet the needs in overall communications. Since 1986, optoelectronic devices and the associated integration technology have been included in the national high-technology research and development plan (i.e., the "863" plan) and have been under the control of the State Science Commission. We are now seeing some preliminary results.

In view of the fact that our resources are limited, the guideline for our future work is that we should not be pursuing everything. Instead, we should focus on target products and fundamental technology that can carry the entire industry. Let us consider the following three levels:

First, let us aim at the needs in the development of optical communications and rapidly form and develop our own optoelectronic information industry. Let us select several major products, such as the long-wavelength laser and optical detector, from existing research accomplishments and manufacture them in quantity in order to take over the domestic market and to compete on the international market. To this end, we have to work very hard to make the transition from a prototype to a product. This transition is a very difficult process. Our products must be practical, high-volume and low-cost, instead of purely high-performance.

Second, in the past decade, a new growth area in semiconductor technology has attracted considerable attention, i.e., the new generation of optoelectronic devices based on superlattice, quantum-well materials. This new generation of optoelectronic devices will be the nucleus of the optoelectronics industry in the 21st century. Consequently, it will be one of the focal points of our future research work.

We must identify products that are targeted for use and marketing in the 21st century, such as single-frequency tunable low-threshold, high-speed lasers and low-noise,

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17 January 1990**

high-speed, high-power, high-gain optical detectors and optical amplifiers. Research and technology-related activities must move forward together. In terms of technology, not only must we make breakthroughs but we must also put things in complete sets so that research and development results can be quickly converted into products.

Third, let us plan to conduct studies on fundamental techniques associated with OEIC's (optoelectronic integrated circuits). In order to do a job well, one must have good tools.

Techniques such as ultra-thin-layer (atomic-level) deposition and ultra-fine machining are prerequisites for optoelectronic integration. In principle, OEIC is primarily a technology problem. Without these basic technologies, there is no way to accomplish optoelectronic integration. Since such basic technology involves a great deal of investment, we must concentrate our limited funds and materials to create a demonstration facility. The objective of this demonstration base is to study fundamental technology and store it for future use, to educate and train talents, and to gradually become the OEIC engineering center in China.

## Developments in Satellite Communications Reported

### 13-Meter Double-Polarized Antenna Tracking System Wins Prize

90CF0079 Beijing ZHONGGUO SHICHANG [ELECTRONICS MARKET] in Chinese 11 Sep 89 p 1

[Article by Jin Deji [4842 1795 1015]]

[Text] The 13-meter double-polarized antenna tracking system developed by the No 14 Institute of the Ministry of Machine-Building and Electronics Industry (MMEI) is ranked among the most advanced systems in the world. Recently, it was awarded First Prize for outstanding scientific achievement by the State Economics Commission.

This tracking system can simultaneously receive and transmit signals with two different polarizations, thus doubling the communications capacity of a system with the same antenna aperture. It is also compatible with the operations of the Intelsat-5 satellite and the future Intelsat-6 satellite. Actual operation of the system over the past 2 years has shown that its performance satisfies the overall technical requirements, and the antenna efficiency is as high as 74-76 percent. The system design has incorporated protective measures against water, sand and salty air; the overall system availability is 99.995 percent, which compares favorably to the international standard of 99.98 percent.

According to reports from the Jiuquan Satellite Launch Center and the Xian-Malan Satellite Ground Station, this 13-meter double-polarized antenna tracking system is clearly superior to similar tracking systems used by other ground stations, and has the capability of tracking any domestic or foreign communications satellite. It can maintain continuous operation for 6,000 hours without failure; it can provide real-time communications service for many of China's operational communications satellites.

### Dual-Beam Satellite TV Receiving System Unveiled

90CF0079 Beijing ZHONGGUO JIDIAN BAO in Chinese 19 Sep 89 p 1

[Article by Zhong Mingyi [6945 0682 0001]]

[Text] The Chinese-built "Twin Star" 3.2-meter dual-beam satellite TV receiving antenna system, marketed for the first time in China, can simultaneously receive television programs from multiple satellites without changing its azimuth or elevation angles. This antenna was developed by the Beijing-Haidian Twin Star Antenna Company under the direction of Dr Shi Xuli of the Beijing Observatory under the Chinese Academy of Sciences. On 22 August, it was certified by MMEI. Experts agree that this antenna meets advanced technical standards found in similar products of other countries.

### First Domestic Double-Polarized Feedline Network

90CF0079 Beijing ZHONGGUO DIANZI BAO in Chinese 26 Sep 89 p 1

[Article by Jin Deji [4842 1795 1015]]

[Text] After 2 years of research and development, the No 14 Institute of MMEI announced in early September that it has succeeded in developing China's first double-polarized small-feedline network system for satellite ground stations. This system is considered to have high technical standards comparable to other advanced systems worldwide.

This system consists of a small corrugated 6-aperture unit, a coaxial low-pass filter, and a 3-aperture unit; it is 470 mm long, 340 mm in diameter, and weighs 15 kg. Compared with the double-polarized network system developed jointly with Canada a few years ago, the new system is  $\frac{1}{2}$  smaller and  $\frac{1}{4}$  lighter; its structure is compact and the product lead time is very short. Test results show that its electrical performance is superior to the specifications of a similar system built by the U.S. Andrew Corporation; its cross-polarization isolation is over 42 dB, its aperture isolation is over 40 dB, its SWR (standing wave ratio) is less than 1.2 dB, and system loss is less than 0.2 dB. It can be used by satellite ground stations in conjunction with a 7.3-m or 9-m antenna aperture; it is considered one of the key systems developed for China's communications industry.

### Satcom, Other Telecommunications Achievements of Institute 54

90CF0079 Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 17 Oct 89 p 2

[Article by Zhang Bingheng [1728 4426 5899] and Jiao Yenlong [3542 1750 7893]]

[Text] During the past 37 years, MMEI's No 54 Institute at Shijiazhuang has developed more than 990 high-technology products in satellite communications and telecommunications. Forty of these products are considered to meet international standards; nearly 400 items are considered to be the most advanced domestic products. Forty-five of the products have received national awards for scientific achievement, and 105 have received prizes at the ministry and provincial level. The institute has made numerous major contributions to the modernization of national defense and to the aerospace industry.

Institute 54 was China's first electronics research institute developed in the early 1950's under the sponsorship of Premier Zhou Enlai and other old-guard revolutionaries. During the early years, it developed many products which were China's "First": in the 1950's it developed China's first ultra-shortwave military transceiver; in the 1960's, it developed China's first high-altitude, long-range multi-channel tropo-scattering communications

system, the first remote-control equipment for aerial and underground nuclear tests, the first radio ballistic ranging system and range-safety remote-control system for missile and satellite launch operations, and the first high-speed instantaneous communications system; and in the 1970's, it developed the first digital satellite ground stations equipped with antennas of apertures of 15 m, 5 m, 1 m and 0.6 m, the first digital scattering communications system and digital microwave relay, the first DS2 and DS3 [8 Mbps and 34 Mbps, respectively] digital microwave relay equipment, and the first microwave short-baseline interferometer system. The institute made a number of significant contributions to China's first atomic bomb test and its first missile launch and satellite launch, as well as to the development of China's satellite communications industry.

After the 11th Party Congress, the reform and opening-up policies injected new vitality into the institute. During the 11-year period since 1978, 845 scientific products have been developed, which is more than five times the total number of products developed over the past 26 years. Today, this institute has evolved into a large, integrated research institution with over 400 senior research scientists and nearly 1,000 engineers; it also provides a good environment for cultivating graduate students at both the master's level and the doctorate level. Each year the institute takes on the tasks of more than 200 new research topics.

In order to improve efficiency, the institute has implemented many innovative reforms since 1986. Specifically, it has reorganized for optimum operational efficiency; it has implemented an integrated budget process in its financial management, and has promoted technical subcontracting and the responsibility system. It has also established and carried out plans for preliminary research, systems engineering development, and test production. Since 1986, the profits generated from the products of scientific and technological research have been growing at a 40 percent rate; this year's total output value is expected to reach 70 million yuan.

#### **Integrated Services Fiber-Optic LAN Developed**

*90CF0039A Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 34, 6 Sep 89 p 1*

[Article by Tu Shizhen [1458 0013 2823]: "Successful Development of Integrated Services Fiber-Optic LAN"]

[Text] The Fiber-Optic Technology Institute of Shanghai Jiaotong University recently succeeded in developing an integrated services fiber-optic bus network, which has passed its technical appraisal by the Shanghai Municipality Science and Technology Commission. The system is an integrated services network having such new equipment as telephone facsimile workstations, data concentrator exchanges, and optoelectronic transponders, all built on the fiber-optic Ethernet base developed in 1986. This constitutes a network that can simultaneously transmit PCM [pulse code modulation] voice, facsimile

(or slow-scan TV), high-speed data (10 megabits/second), and low-speed data (1K bit/second). The network diameter can be as great as 4 km. The fiber-optic network can be conveniently connected to cable Ethernet networks and to telephone lines. The telephone facsimile workstation has an exclusive PABX that can connect 100 telephone sets or fax machines in implementing intra-station time-division programmed circuit switching, and can implement voice and facsimile packet switching among various workstations at a rate of 10 megabits/second over a fiber-optic bus (or even over coaxial cable). Data concentrator exchanges can connect 14 computers having RS-232C port packet switching of data, and they can concentrate the data put into the network by these computers using statistical time-division multiplexing modes to send data at the rate of 10 megabits/second into fiber-optic network or cable Ethernet, thereby effecting communication among the networked computers. The designed capacity of this network is 1,500 telephones or fax machines and 100-200 computers; it is therefore suitable for use by medium to large factories and enterprises, government organizations, and military units where there are larger network diameters and that require excellent anti-electrostatic interference and security.

Experts of the appraisal committee concluded that: this is the first successful domestically developed integrated services fiber-optic local area network, that it fills a void in China, and that it meets advanced international standards for such products as of the 1980s. It has been an important breakthrough regarding development of China's fiber-optic communications from point-to-point communications to integrated services digital networks. Within a short time, this network can be brought to the level necessary for application, when it can then go into operation.

#### **More Details on Integrated Digital Network**

*90CF0039B Beijing DIANXIN JISHU [TELECOMMUNICATIONS TECHNOLOGY] in Chinese No 7, Jul 89 p 47 [see earlier report in JPRS-CST-89-018, 22 Sep 89 p 91]*

[Untitled article by Mu Yancheng [4476 3601 1004]]

[Text] In Beijing on 15 May, a state-sponsored major science and technology project, the first Chinese-manufactured "[stored] program-controlled (SPC) digital [telephone] exchange/fiber-optic-cable communications system joint test project," passed an evaluation and appraisal arranged by the state.

At present, SPC digital exchanges and fiber-optic-cable communications systems used in medium to large cities for developing telephone communications are dependent upon imports. Two relevant research achievements were realized during China's Sixth 5-Year Plan, with the DS-2000 SPC digital exchange and the multi-mode long-wave length fiber-optic DS3 [i.e., 34 Mbps] optical

communications system. To further verify the feasibility, economic reasonableness, and operational stability of the technology used in communications systems with these two achievements, in 1984 the State Planning Commission determined that through industrial testing at a production scale carried out by the Ministry of Posts and Telecommunications (MPT), the two achievements would constitute an integrated digital communications network (IDN) of significant scale, to be incorporated into the public communications network. On the one hand, this project would test many new communications services on this network, and on the other, it would assume regular communications services.

This test project was the responsibility of the Institute of Posts and Telecommunications Sciences under MPT; more than 20 research, design, construction, and applications units took part over more than 4 years. The test project used an IDN made up from five SPC digital exchanges (two DS-2000 units made in China and three S-1240 units manufactured by the Sino-Belgian Joint Venture Company) and five fiber-optic-cable communications systems with a total length of 20.4 km. This is the first time domestically manufactured equipment has been used to constitute an IDN in China. After more than 2 years of on-network actual operation and various technological testing, it was proven that the performance of the China-manufactured SPC digital exchange is stable, that on-network functions are normal, that it is conveniently compatible with other kinds of SPC digital exchanges and transmission systems, and that various service functions can be performed on the network; the transmission characteristics and stability of the long-wave length DS3 fiber-optic-cable communications system all achieve the requirements of design specifications; the IDN formed from these elements is fully capable of meeting the communications needs of intra-network generated telephone service and of such non-speech services as data and facsimile; and that communications quality complies with relevant recommendations for national standards and international electronic networks.

The experts concluded that this test project and technologically met international standards of the 1980s, that the engineering quality was excellent, that it was economically reasonable, and that the equipment and network-formation technology used during the project may be disseminated throughout China for use in constructing communications networks. The success of the test project has major significance for encouraging advances in China's communications science and technology, for encouraging a greater degree of domestic manufacture for advanced communications equipment, and for changing the situation in which we primarily depend upon imports for advanced communications equipment. And this has laid the technological foundation in China for future development of communications network technology to even higher levels.

#### Millimeter-Wave Communications Success Reported

90CF0039C Beijing WUXIANDIAN [RADIO] in Chinese No 8, Aug 89 p 4

[Article by Can Xiang [3503 4382] and Cai Yun [5591 0061]: "China's First 8mm Communicator Is Successfully Tested"]

[Text] The first 8mm communicator developed in China was recently successfully tested at a certain maintenance station in the Jinan Military Region.

This equipment was commissioned by the General Staff Headquarters, was jointly developed by Xidian University [formerly Northwest Institute of Telecommunications Engineering] and by Institute No 20 of the Ministry of Machine-Building and Electronics Industry, and it was one of the key projects of the national Seventh 5-Year Plan. It can be used in place of 300 circuits and 960 wired carrier circuits, it can transmit bidirectional color television or 30 digital circuits, and it has such features as quickness, accuracy, security, and non-interruption.

The successful development of this equipment indicates that millimeter-wave communications has reached the state of application in China, which opens a new field for China's communications services, and it will play an especially important role in such emergency situations as disaster relief.

#### Automatic Packet Network Controller Developed by Military

90CF0039D Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese No 35, 13 Sep 89 p 20

[Article by Zhao Bingyue [6392 3521 6460]: "Radio Communications Automatic Packet Network Controller Is Developed Successfully in Jinan"]

[Text] To make full use of existing communications equipment, scientists and technicians at the Command Automation Work Station of the Jinan Military Region are using the TP-801 single-board computer without adjusting any component of a single-sideband transceiver. In this way, they have augmented serial communications ports and peripheral controller circuits, written network control programs, and successfully developed a radio packet network controller; these activities have enabled radio communications technology to be under the control of automatic computer management, which in turn has improved communications efficiency ten-fold.

The controller is based upon their unique radio network control standard, which has the following functions and features:

1. It uses master-slave point-to-multipoint network topology under the concentrated control of the host

station over the affiliated stations, where within prescribed periods, the host initiates affiliation with the remotes, which avoids signal conflict problems with responses to host calls.

2. It can automatically monitor remote working conditions.

3. It can integrate wired and wireless communications into an entity that monitors wireless-network and wired-network interface control and communication states, and it can accomplish automatic switching between the two circuits.

4. They have considered the working efficiency of the networker, and have used even parity checking to accomplish the error-checking function of channel signals.
5. They have retained the hidden signals and calls in traditional communications to guarantee the security and reliability of the communications network.
6. They have used simultaneous automatic and manual methods, which allows a person to still be the master of communications.
7. Because pauses in signal spaces are short, data encryption performance has been significantly improved.

**Lanzhou Heavy-Ion Accelerator Update**  
*90CF0121A Beijing RENMIN RIBAO in Chinese*  
*11 Nov 89 p 2*

[Article by reporter Tian Hengjiang [3944 1854 3068] and correspondent Song Wenjie [1345 2429 2638]; "Lanzhou Heavy-Ion Accelerator Soon in Operation"]

[Text] Lanzhou, 10 Nov (XINHUA)—The Lanzhou Heavy-Ion Accelerator passed the completion inspection conducted by a state certification commission today. This heavy-ion accelerator, the highest in energy, most in the types of ions to be accelerated, and largest in scale, will be officially put into operation in the near future.

Prior to today, a state approval commission certified the technical aspects of the accelerator on the 9th.

The Lanzhou Heavy-Ion Accelerator was designed, constructed, installed, and tested by the vast number of technical staff and workers at the Institute of Modern Physics of the Chinese Academy of Sciences (CAS) based on absorption of advanced foreign science and technology. They insisted on being independent and on building up the country through thrift and hard work. After 13 years of hard work, the project was completed and a beam was generated in December 1988. This is the third such large cyclotron in the world, right behind France and Japan.

A heavy-ion accelerator is an important piece of equipment in basic and applied research on heavy-ion nuclear physics. A heavy-ion beam has a wide range of applications in solid-state physics, atomic physics, molecular physics, materials science, radiation biology, radiation medicine, and many other areas involving agricultural and industrial production.

After nearly 5,000 hours of testing, the acceleration level of the Lanzhou heavy-ion accelerator continued to rise and all technical specifications were met, including beam intensity and quality. The heavy-ion beam generated by this piece of domestically built equipment has been used in three medium-energy-level heavy-ion nuclear reaction studies and a study on radiation damage of materials. This opens a chapter in this area of research in China.

After listening to the technical certification and engineering completion reports from CAS, a state inspection and acceptance commission visited the site and reviewed, checked and accepted the certification results, technical equipment, engineering quality, financial budget and final accounting, materials management, and files. The project was viewed to be completed according to plan. The design was considered to be rational, the equipment fairly complete, and the quality of construction good. The accelerator and all systems have met design targets. Its performance level is comparable to that of other similar accelerators built in the 1980's; consequently, China is becoming a leader in the design and construction of heavy-ion cyclotrons in the world. The radiation protection system is well designed and

equipped based on advanced technology. It meets national standards and will not harm the environment.

CAS also issued citations to praise the entire technical staff, workers and officials involved in the development and construction of the Lanzhou Heavy-Ion Accelerator.

**Background of Nation's First Synchrotron Radiation Accelerator**

*90CF0121B Beijing GUANGMING RIBAO in Chinese*  
*18 Oct 89 p 2*

[Article by Xue Changci [5641 2490 6101]; "A Song of Light—the Birth of China's First Synchrotron Accelerator"]

[Text] On early morning 26 April 1989, light was emitted from China's first dedicated synchrotron radiation facility, a high-technology installation located in the southern suburb of Hefei. This event signaled that China had reached world class in the development of synchrotron radiation devices.

In 1976 China Science and Technology University was revived after moving to Hefei. A number of young teachers searched for topics in their own special disciplines which are meaningful to China's future technical development. Four departments and one teaching and research office focused their efforts on the research and development of accelerators, specifically on synchrotron radiation.

Synchrotron radiation is a new application of accelerators which was developed in the 1970's. Within a short period of time, it has been widely used in materials science, life sciences, physics, medicine, chemistry, and lithography of VLSI (very-large-scale integration) circuitry. It shows an unlimited potential and developed nations are competing to build such facilities.

In June 1977, China Science and Technology University realized that the government was interested in synchrotron radiation research from a draft of the national natural science plan. Four departments and the physics teaching and research office immediately expressed willingness to undertake this project and received enthusiastic support from the leadership of the school and a number of experts. In the science planning meeting, China Science and Technology University won the assignment based on a detailed plan.

A synchrotron radiation facility is more than a high-technology research tool, it is the culmination and combination of a number of separately developed cutting-edge technologies. Responsible for its development were only 23 faculty members in the four departments and one teaching and research office at China Science and Technology University. The oldest teacher was 40 with a title of lecturer; others were unknown figures. These young people worked very hard for science and for their country.

In 1978 China Science and Technology University spent all its resources to support the preliminary engineering development and physical design of the project. In order to train technical people, the university systematically sent people to visit or work in developed nations and invited foreign scholars to lecture in China.

At the same time, China Science and Technology University began fabrication of key components. In 1981, preliminary development and physical design were completed and the linear accelerator, ultra-high vacuum equipment, and magnets were successfully fabricated. In the review meeting, over 50 experts were impressed by the components on display. In April 1983 the State Planning Commission officially approved the synchrotron radiation project as a national project. On 20 November 1984 construction began.

Since there was no synchrotron radiation facility in China, some people suggested that we should copy the plot from another country to be on the safe side; however, the price to pay is that we will always be following other people's footsteps. People who were sent out to visit other countries have the same feeling, i.e., suppression: we were not in an equal position in terms of exchange and learning. The atmosphere of being looked down upon is suffocating. Thus, we decided to independently develop our own world-class synchrotron radiation facility for our own use.

There are several technical hurdles in developing a synchrotron radiation facility, such as the linear accelerator, magnets, ultra-high-vacuum equipment, and high-frequency cavity involving over 10 technical disciplines including mechanical engineering, vacuum technology, electronics, computers, microwave technology, and special materials. Furthermore, the accuracy requirement is very high. A small mistake might lead to overall failure.

Before construction began, physical and engineering designs were carefully reviewed and technical circuits rigorously analyzed for each sub-system and for the overall system.

The design of each component was accepted based on the level of machining required. The plant encountered numerous difficulties in machining. Because many parts were uniquely designed with a very high accuracy requirement, designers had to stay at the shop to provide technical assistance. In addition to taking all the risks, they had to cooperate fully with the plant.

The production of magnets is critical. The entire project needed 12 bipolar curved magnets, 32 quadrupolar magnets and 14 hexapolar magnets. Each piece weighs nearly 4 tons. The magnets were fabricated in one piece in pilot production. Later, they were made by bonding pieces together. It is necessary to maintain a certain degree of curvature. Usually, people try to avoid making curved magnets because of the difficulty involved. Each bipolar magnet has 1,600 sheets of iron, and every piece must be uniform to ensure the homogeneity of the overall magnetic field. The tolerance must be within six parts in ten thousand to guarantee low fluctuation. The entire process, from design to fabrication, was brand new; it was a very difficult job. A small mistake might cost over 1 million yuan. Each step had to be taken carefully: materials were carefully selected, and every piece was delicately machined and carefully matched during bonding. These dozens of magnets took them 4 years to finish. They were individually tested and were found to be at world class. An American expert intends to recommend these magnets to the rest of the world.

The synchrotron radiation facility required more than 1,000 drawings and hundreds of major components. With the exception of the imported control system and some imported raw materials for certain key pieces of equipment, almost all (over 95 percent) of the components were made domestically.

From preliminary development to emitting light, it took 10 years for these technical people to rely on their collective wisdom to finish this 11,000-square-meter facility with China's own industrial strength. This first Chinese synchrotron radiation facility has been recognized by the rest of the world.